THE AMERICANA

A Universal Reference Library

Comprising the
Arts and Sciences,
Literature, History, Biography,
Geography, Commerce,
etc., of the world

EDITOR-IN-CHIEF
Frederick Converse Beach
EDITOR SCIENTIFIC AMERICAN

MANAGING EDITOR
George Edwin Rines.

ASSISTED BY MORE THAN ONE THOUSAND
EMINENT SCHOLARS AND AUTHORITIES

Issued Under the Editorial Supervision
of The Scientific American

SIXTEEN VOLUMES

Scientific American
Compiling Department
258 & 260 Fifth Avenue
New York

THE ENCYCLOPEDIA AMERICANA

DEPARTMENT AND ADVISORY EDITORS

ASTRONOMY
SIMON NEWCOMB, Ph.D., LL.D., D.Sc
Astronomer
Washington D. C.

PHILOSOPHY
JAMES E. CREIGHTON, A.M., Ph.D.
Professor of Philosophy, Cornell University
Ithaca, N. Y.

PHYSICS
ROBERT S. WOODWARD, Ph.D., LL.D.
President Carnegie Institution
Washington, D. C.

PURE MATHEMATICS
CASSIUS J. KEYSER, M.A., Ph.D.
Adrain Professor of Mathematics
Columbia University, New York

ARCHITECTURE AND THE FINE ARTS
RUSSELL STURGIS, F.A.I.A.
New York City

ZOÖLOGY
DAVID STARR JORDAN, Ph.D., LL.D.
President Leland Stanford Jr. University
Palo Alto, Cal.

LITERATURE
EDWARD EVERETT HALE, S.T.D.,
Boston, Mass.

CLASSICAL LITERATURE
JAMES HAMPTON KIRKLAND, Ph.D., LL.D.
Chancellor Vanderbilt University
Nashville, Tenn.

EDUCATION
ANDREW SLOAN DRAPER, LL.D.
Commissioner of Education, State of New York
Albany, N. Y.

HISTORY OF THE UNITED STATES
(Vol. XV)
ANDREW C. McLAUGHLIN, A.M.
Editor "American Historical Review"
Carnegie Institution, Washington, D. C.

RELIGION AND THEOLOGY
SYLVESTER BURNHAM, D.D.
Dean of Hamilton Theological Seminary
Colgate University, Hamilton, N. Y.

CHEMISTRY
ALLAN DOUGLAS RISTEEN, Ph.D.
Hartford, Conn.

MINERALOGY
GEORGE LETCHWORTH ENGLISH
Member Association for the Advancement of Science
New York City

ELECTRICITY
WILLIAM MAVER, Jr., C.E.
Consulting Electrical Engineer
New York

ENGINEERING AND MACHINERY
WILLIAM MOREY, Jr., C.E.
Consulting Civil and Mechanical Engineer
New York

RAILROADS
EDWARD S. FARROW
Consulting Railroad Engineer New York

MEDICINE
SMITH ELY JELLIFFE, M.D., Ph.D.
Editor "Medical News" New York

LAW
HENRY M. EARLE
Attorney at Law, New York

ROMAN CATHOLIC TOPICS
P. A. HALPIN
Emeritus Professor of Metaphysics and Ethics

CANADIAN EDITORS

GEORGE McKINNON WRONG, A.M.
Professor of History, University of Toronto
Toronto

CHARLES WILLIAM COLBY, A.M., Ph.D.
Professor of History, McGill University
Montreal

A Few of the Leading Articles in Volume One

WRITTEN AND SIGNED BY SPECIALISTS

ABNORMAL PSYCHOLOGY	ISAAC M. BENTLEY Assistant Professor of Psychology, Cornell University
ACOUSTICS	WALLACE CLEMENT SABINE Assistant Professor of Physics, Harvard University
ADULT EDUCATION	HENRY M. LEIPZIGER Supervisor of Lectures, New York Board of Education
ADVERTISING	FRANK PRESBREY The Frank Presbrey Company, New York
AGATE	GEORGE LETCHWORTH ENGLISH Mineralogist, New York City
AGRICULTURAL EDUCATION	CHARLES W. DABNEY President of the University of Cincinnati
AIR BRAKE	R. A. PARKE Expert for Westinghouse Company
ALABAMA	JOHN WITHERSPOON DUBOSE Author of 'Life and Times of Yancey'
ALASKA, RECENT DEVELOPMENT OF	WILLIAM R. STEWART Editorial Staff 'New York Daily News'
ALASKA, COMMERCIAL	WALTER J. BALLARD Expert Statistician, Schenectady, N. Y.
ALBANY, N. Y.	WILLIAM BOUCHER JONES Secretary Albany Chamber of Commerce
ALGEBRA	CASSIUS J. KEYSER Adrian Professor of Mathematics, Columbia University
ALUMINO-THERMICS	EDWARD S. FARROW Consulting Railroad and Mining Engineer, New York
AMERICA	FORREST MORGAN Connecticut Historical Society
AMERICA, DISCOVERY AND COLONIZATION	CHARLES WORTHEN SPENCER Professor of History, Colgate University
AMERICA, UNITED STATES OF	FREDERICK W. WEBBER, M.A.
AMERICAN DIPLOMACY	JOHN W. FOSTER Author of 'A Century of American Diplomacy'
AMERICAN FARM IMPLEMENTS	R. L. ARDREY Chicago, Ill.
AMERICAN FEDERATION OF LABOR	SAMUEL GOMPERS President American Federation of Labor
AMERICANISMS	JOSEPH FITZGERALD Author of 'Word and Phrase'
AMERICAN LABOR	CARROLL D. WRIGHT Formerly U. S. Commissioner of Labor
AMERICAN LITERATURE	EDWARD EVERETT HALE Author of 'The Man Without a Country'
AMERICAN MANUFACTURES	EDWARD D. JONES University of Michigan
AMERICAN MINES	EDWARD S. FARROW Consulting Railroad and Mining Engineer, New York
AMERICAN NEWSPAPERS	CHARLES H. TAYLOR Editor of the 'Boston Globe'
AMERICAN POLITICAL ISSUES	CHARLES FRANCIS ADAMS Historian and Diplomat
AMERICAN PRINTING TRADE	A. B. NICHOLS The Herald Company of Binghamton
AMERICAN PUBLISHING	H. H. MCCLURE Of McClure, Phillips & Co., New York
AMERICAN RAILROADS	EDWARD S. FARROW Consulting Railroad and Mining Engineer, New York

AMERICAN STREET RAILWAYS — EDWARD S. FARROW
Consulting Railroad Engineer, New York

AMERICAN UNIVERSITY, THE — EDWARD DELAVAN PERRY
Columbia University, New York

ANALYSIS SITUS — PAUL WERNICKE
Professor of Mathematics, State College of Kentucky

ANATOMY — SMITH ELY JELLIFFE, M.D.
Editor 'Journal of Nervous Diseases'

ANATOMY, COMPARATIVE — EDWIN GRANT CONKLIN
Professor of Zoology, University of Pennsylvania

ANATOMY OF PLANTS — HERMON THEODOR HOLM
Expert Botanist, Washington, D. C.

ANT — A. S. PACKARD
Late Professor of Zoology, Brown University

ANTHROPOLOGY, AMERICAN — W. J. MCGEE
Smithsonian Institution

APOLOGETICS — GEORGE WM. KNOX, D.D.
Professor of Philosophy and History of Religion, Union Theological Seminary

APPALACHIAN AMERICA — W. G. FROST
President Berea College

APPENDICITIS — JOHN B. DEAVER, M.D.
Specialist, Philadelphia, Pa.

AQUINAS, SAINT THOMAS, PHILOSOPHY OF — WILLIAM TURNER, S.T.D.
Saint Paul Seminary, Saint Paul, Minn.

ARCHÆOLOGY, AMERICAN — CHARLES CONRAD ABBOTT, M.D.
Archæologist

ARCHITECTURE AND AMERICAN ARCHITECTURE — RUSSELL STURGIS, F.A.I.A.
Author of 'Dictionary of Architecture'

ARCHITECTURE, EDUCATION IN — HENRY R. MARSHALL
Fellow American Institute of Architects, New York

ARISTOTLE — JAMES E. CREIGHTON
Professor of Philosophy, Cornell University

ARISTOTELIANISM — WILLIAM A. HAMMOND
Professor of Ancient and Mediæval Philosophy, Cornell University

ARITHMETIC — DAVID EUGENE SMITH
Professor of Mathematics, Teachers' College, Columbia University

ARIZONA — F. W. HODGE
Smithsonian Institution, Washington, D. C.

ARKANSAS — U. M. ROSE
Ex-President American Bar Association

ARMAMENT OF THE WORLD — CAPT. EDWARD S. FARROW
Late Assistant Instructor of Tactics at the United States Military Academy

ARMY AND NAVY — ALFRED T. MAHAN
Author of 'Influence of Sea Power' etc.

ARMY OF THE UNITED STATES, THE — H. C. CORBIN
Major-General and Adjutant-General, U. S. A.

ARMY AND NAVY MANEUVERS — COL. W. A. SIMPSON
Asst. Adjt.-Gen. U. S. Army

ARMY TRANSPORT SERVICE — WILLIAM H. CARTER
Brigadier-General General Staff

ART — CHARLES H. MILLER, N.A.
Municipal Art Society, New York

ARTHROPODA — A. S. PACKARD
Late Professor of Zoology, Brown University

ASSEMBLAGES — CASSIUS J. KEYSER
Adrian Professor of Mathematics, Columbia University

ASSOCIATION OF IDEAS — ISAAC M. BENTLEY
Assistant Professor of Psychology, Cornell University

ASSYRIOLOGY — IRA M. PRICE
Professor of Semetic Language and Literature, University of Chicago

ASTRO-PHOTOGRAPHY — F. S. LUTHER
Of Trinity College

ASTRONOMY; ASTRONOMY, HISTORY OF; ASTRONOMY, PRACTICAL; ASTRONOMY, THEORETICAL — SIMON NEWCOMB
Astronomer and Scientist

ASTROPHYSICS — S. A. MITCHELL
Department of Astronomy, Columbia University

KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
a̤	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, over: also Fr. *e*, as in *de; eu*, as in *neuf;* and *oeu*, as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie*.
ẹ	befall, elope
ẽ	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or H	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
ị	between e and i, mostly in Oriental final syllables, as, Ferid-ud-din
j	gem, genius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*

ñ	Span. *ñ*, as in *cañon* (căn'yŏn), *piñon* (pēn'yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ö or oo	fool, rule
ou or ow	allow, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
t͟h	father, thither
ū	mute, use
u or ŭ	but, us
u̇	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure

' (prime), " (secondary) accents, to indicate syllabic stress

INTRODUCTORY.

THE publication of a great reference work like the ENCYCLOPEDIA AMERICANA is an undertaking of such supreme importance and responsibility that the reasons and purposes which have inspired the publishers and editors to undertake its production, at such great expense and involving so many years of preparation, should be briefly summarized.

First.— After surveying the encyclopedic field very carefully the publishers of the AMERICANA were convinced that no work had as yet appeared which gave to America — her history, literature, biography, geography, industries and commerce — that thorough and careful treatment which the rapidly advancing life and importance of the nation made imperative. They also believed that the time was auspicious for the production by Americans, who alone could appreciate and faithfully represent the life, thought, and need of their own country, of a National Work — so broad, comprehensive and genuinely great that it would everywhere be recognized as the product of native genius, and be acknowledged worthy of the great people for whom it was prepared. This was the Ideal, and upon this foundation the whole superstructure has been built, the result being the natural and harmonious development of the entire sixteen volumes, because for the first time a sustained and systematic attempt has been made to make a distinctively American encyclopedia. It naturally follows, therefore, that the AMERICANA differs from all other similar productions, and it is this difference which makes it superior as a reference work of information for the American people.

Second.—The AMERICANA is designed to give complete and practical information. Its scope is universal — there is absolutely no subject that should be included in such a work that does not find its place somewhere in the AMERICANA, but the practical utility of the work has constantly been kept in view, with the result that the relative importance of subjects, both foreign and American, has been most carefully gauged by the editors, rendering the AMERICANA of the greatest practical service. All modern encyclopedias have followed, to a greater or less degree, the path marked out by earlier works, omitting much of present-day interest, and continuing second-rate topics of little or no importance. The AMERICANA has not hesitated to make a new departure and eliminate this dead-wood, and in its place the reader will find hundreds of important topics treated that are not even mentioned in other works, besides a great amount of what might be called miscellaneous information, including biographical and geographical names, actual and legendary characters in fiction, notable buildings, works of art, books, plays, operas, etc. It will be seen therefore, that the AMERICANA contains more subjects of living practical interest to Americans than any other encyclopedia in existence. The maps and illustrations have been prepared especially for the AMERICANA at a large expenditure, and they will be found so numerous, correct, interesting and helpful as to lend great charm and value to the work.

Third.— The AMERICANA is designed to be the standard authority in this country upon all subjects covered in its pages. No existing source of information has been relied

upon. Important articles are written by America's leading scholars and authorities, and are signed by their respective authors, so that the reader knows at once the source of his information. Every department has had the active editorial supervision of men eminent in their professions in this country, and it is largely to the untiring devotion and the intelligent work and advice of the associate editors on the staff that the Americana owes its majestic originality of conception and treatment, and the marvelous success which has attended every stage of its production. In this connection the acknowledgment of publishers and editors is due to the more than one thousand contributors to the Americana for the generous and patriotic manner in which they have responded, giving their time and invaluable service in order that America might have a thoroughly representative encyclopedia. The Americana represents, to a far greater extent than any other reference work, the authority of American scholarship and successful practical experience, and must prove indispensable for the daily use of the scholar, the statesman, the student, the professional or business man, and especially to the home circle.

Fourth.—The articles of the Americana are written in a style to commend it to the judgment of all. Clear, concise, comprehensive and attractive, the seeker for information will find the pages of the Americana a perfect delight, so different from the heavy, dull encyclopedic style, while the ease and convenience with which it may be consulted, the fulness of its cross-references, and the richness and recency of its information render it the most useful, valuable, and popular work yet offered to the American public.

While not ignoring the lessons to be learned from the great works of the past and present, the Encyclopedia Americana has independently made its own way along new lines, profiting both by the excellencies and defects of its predecessors and contemporaries, and it stands to-day the Twentieth Century's monument to American genius, scholarship, and energy.

Believing therefore that the Encyclopedia Americana represents in its plan and purpose, its arrangement and treatment, its scholarship and authority, an advance upon all former reference works, it is respectfully dedicated by its editors to the American people, whose life and progress it so fully and faithfully portrays.

Frederick Converse Beach

THE ENCYCLOPEDIA AMERICANA

A the first letter of every alphabet except the old German or Runic and the Ethiopian: the « futhark » of the former places it fourth, the latter makes it thirteenth. As all alphabets ultimately come through the Phœnician (witness the name itself), this arrangement is natural. Our own is inherited from the Latin, which was derived from the Greek; and the latter in its *alpha* confirms its traditional derivation from the Phœnician where and in Hebrew it is called *aleph*, Aramaic *alph*. The name is said to have meant « ox,» and so strongly resembles the root-element of eleph-ant that there is little doubt the original meaning of both was the same. Hence formerly the shape of the lower-case a was derived by some from the rough outline of an ox-head with its horns; but in fact, as evidenced by a comparison of the gradual evolution of forms, the small letters in all cases are derived from the capitals, and the Greek capital A (see table under ALPHABET) in its original shape was a somewhat more cursive form of the Phœnician aleph, which itself was a conventionalized form of the Egyptian hieratic, and that in turn (the final step backward) was conventionalized from the picture of an ibis in the ancient Egyptian hieroglyphics or ideographs.

The sound of the letter has varied little more than the form — perhaps less — except in modern English, which owing to its composite character has made it a symbol of so many different vowel-sounds as to be well-nigh meaningless. Yet even here most of them have never quite lost connection with the earlier vocal efforts it stood for, and their fluctuations are fixed by the character of the vocal opening. The Phœnician sound represented by the letter aleph cannot have corresponded to the Greek alpha or any of its derivatives, as the former alphabet assumed that all syllables began with consonants, and aleph was in some sort consonantal; but the Greeks made it a pure vowel, the so-called « Continental » or broad *a* as in « ah.» This is the simplest and most fundamental of all vowel-sounds, the earliest uttered by infants,— whence many grotesque theories of its divine origin and the reasons for its position,— since it results from opening the throat and mouth wide and emitting the tone from the larynx, with the least friction or interference possible from the other organs; and it is still the most general on the Continent of Europe. But even there it has been largely flattened by the French into the short sound as in « at »; at the end of words in all languages the dropping of the voice tends to slur it toward the sound of u in « but,» which in English it quite attains; and with us it has become the representative of nine distinct sounds, seven of them each recognizably developed from one of the others, and all from the parent sound, while two are of a different order, yet still explicable. The usual arrangement (« fate, fat, far, fall,» etc.) is entirely misleading, as it obliterates this evolution, which the following makes clear:

(1) *a*h, explained above.

(2) *a*ll, a closer sound than (1), formed by drawing back the tongue, compressing the sides of the throat, and speaking more toward the diaphragm. In general utterance this is perhaps the first change from *ah*. It is almost universal among the Hindu and Persian masses (« ghaut » for ghät, etc.), and was very common in England and America in the 18th century: witness pronunciations like « spaw » for « spa »; the curious aberrant « vawz » for vahz, which has more curiously become accepted as a sort of social touchstone in a small group; family names like R*a*leigh, Dec*a*tur, T*a*ney, etc., in American pronunciation.

(3) w*a*s, wh*a*t. The same pronounced still deeper in the diaphragm, and cut short instead of prolonged.

(4) ov*a*l. This is the «neutral» sound, corresponding to « short u »; used in Western languages only in unaccented syllables, and made by lazily opening the organs as little as possible and putting no stress on the expiration of the breath. It is the closest of the vowel-sounds, and the most diaphragmal, and therefore seemingly the antithesis of « broad a »; it has in truth no special relation to that more than to *e* and *o* (« sil*e*nt,» « apr*o*n »), but is the common

weakened form of all. In Hindu speech it is used stressed, as in the familiar « Juggernaut » (Jaganath), « Buckergunge » (Bakarganj), etc.

(5) *bare*. An opener sound than (1), formed in precisely the same manner as (2) except by expanding instead of contracting the throat.

(6) *at*. Identical with (5) except being cut short instead of prolonged; in fact, its short sound.

(7) *ask*. Always a different sound from the others, but not always the same in itself. With the less cultivated speakers it is nearly identical with (5), even with (6). With others, anxious to avoid this flatness and exaggerating in the opposite direction, it is made identical with (1). With the majority of good speakers it is akin to (1), but shorter and more diaphragmal, and with the organs rather closer together.

(8) *any, many*. This is not one of the group of *a*-sounds, but is « short e.» The change was caused by assimilation of the *a*-sound to the *i*-sound of the closing letter.

(9) *ate*. This, in usual order the first given, considered the typical English *a*-sound, and actually furnishing the pronunciation of that letter in its alphabetic position, is not merely not an *a*-sound at all, but not even a simple vowel-sound, being nearly ĕĭ, sliding quickly from a closer and more diaphragmal « short e » to a vanishing sound of « short i.» As in (8), the cause appears to have been originally assimilation with a final vowel (the sonant *e* now so often silent but « lengthening » the *a* before it), and afterwards extended to words where this principle could not act.

A, in general, the first term of any series.

In music, the first note of the scale of A, major minor; and A minor is the relative (or related) minor of (or belonging to) C major; the Continental *la*. The open second string of the violin sounds it, and the instruments of an orchestra are all tuned to it.

In logic, the universal affirmative (« all trade is barter »), distinguished from the particular affirmative (« some trade is barter »). See Logic.

In algebra, the first letters of the alphabet, *a, b, c*, etc., are used to denote known quantities, while the last, down to *z*, denote the unknown,— *a* and *x* being used first in all cases, the others being added according to need.

In geometry and mechanical diagrams, the capitals A, B, C, etc., are used to mark off points, lines, angles, and figures; in complicated diagrams, often supplemented by the small letters and accented, to indicate closer relations of parts.

As an abbreviation see Abbreviations.

As an adjective or attributive, shaped like the letter A; as, an A tent.

A, word. (1) The form of « an » used before consonants. (2) Broken-down form of « on,» or ellipsis of « for a » (« twice a day »). (3) Old form of « ah,» as a war-cry (« A Douglas! »).

A1, ā-one' (colloquially, «first-class»), the mark for highest-grade wooden vessels in Lloyd's (q.v.) «Register of Shipping.» **A** refers to hull, 1 to rigging and equipment. This rank is assigned by Lloyd's surveyors to new ships for a term of years (prefixed to the symbol, as 10A1) dependent on quality of materials and mode of building; but to retain it they must be periodically resurveyed, and if fit are granted continuation for one to eight years, marked 10A1 Cont. 5A1, etc. **A** in red means over-age, but still fit for any voyages which perishable goods can endure; **A** in black, fit for short trips with similar goods. In all cases the 1 is omitted if rigging, etc., are inferior. Iron and steel vessels have a Gothic **A** preceded by numerals from 100 down, 100**A** to 90**A** resurveyed once in four years, 85**A** and below once in three; rigging, etc., marked same as on wooden ships. In the German Lloyd's **A1** and **A** are the two best grades of wooden ships; **B1, B, CL,** and **CK,** lower ones; iron and steel ships are marked as in the English classification, but with the resurvey term marked under the **A**.

Aa, ä («water»: a general Indo-European word in various shapes,— Ger. *ach* or *aach* in Aachen, Biberach, etc.; Lat. *aqua*, pl. *aquæ*, whence O.F. Aigues, Mod.F. Aix, in compounds; etc.), the name of some forty streams in northern and central Europe: among the chief, a French river rising in dept. Pas-de-Calais, flowing into dept. Nord, and reaching the Strait of Dover at Gravelines; about 50 m. long, navigable below St. Omer, and connected with Calais and Dunkirk by canals.

Aachen, ä'Hen. See Aix-la-Chapelle.

Aahmes I., ä'mess, the founder of the 18th dynasty in Egypt, c. 1600 B.C., and its final liberator from the Hyksos or Shepherd Kings, Asiatic nomads who had conquered the land a century or two before. Native kings had already recovered it in part; but Aahmes captured the last Hyksos fortress, Hatwaret (Awaris), expelled them from Egypt, and followed them into southern Palestine, besieged their army five years in "Sharuhen" and captured it. He then penetrated farther into Palestine, levying tribute on it and on the seaboard. This began a long series of Egyptian retaliatory expeditions into West Asia and a long dominance over it. He had an admiral of the same name, whose self-laudatory inscription on his tomb is a most valuable mine of knowledge on the military and naval operations of the time. Aahmes-Nefertari was his queen: her mummy-case, one of the most magnificent ever discovered, is in the museum at Gizeh.

Aahmes II., the **Amasis** of Herodotus, fifth Pharaoh of the 26th dynasty, c. 570–526 B.C. An officer of Apries headed a revolt against him, and overthrew and killed him. Though he seems to have risen from the ranks, and to have loved roystering and disliked royal etiquette, he made a capable and judicious sovereign; saved Egypt from conquest by Nebuchadrezzar (who ravaged it, but retreated), and managed to preserve it from invasion by Cyrus the Great. He was on very friendly terms with the Greeks: lending his influence to promote their commerce and colonization; assigning them the excellent port of Naucratis, which soon grew into a flourishing city; contributing liberally toward the rebuilding of the burned temple at Delphi; and according to Greek story having cordial relations with several philosophers and princes — Pythagoras, Polycrates, etc. Under the reign of Aahmes Egypt enjoyed much prosperity.

Aalborg, âl'bork («eel-town»), Denmark, the chief city of N. Jutland; on the S. side of the Limfjord (a sea-arm which joins the Cattegat to the North Sea), and on the Danish State Ry., which crosses the fjord by an iron bridge 1,250 feet long, one of the finest pieces of engineering in the kingdom. An important commercial town as far back as the 11th century (Wallenstein sacked it in 1627, the Swedes in 1644 and 1657), despite a shallow harbor it still has much trade, by means of small vessels, with Scandinavia and England; while its manufactures — distilleries, leather, lumber, soap, cement, cotton goods, etc.— are now building it up with great rapidity. A bishop's seat, it has a cathedral; also two old churches and an old castle, a museum, and a library of 30,000 volumes. Pop. (1890) 19,503; (1901) 31,462.

Aalesund. See ALESUND.

Aali Pasha, Mehemed Emin, ä-lē' pä-shä', mĕ-hĕm-ed' ā-min', a Turkish statesman: b. Constantinople 1815; d. 6 Sept. 1871. Entering public life at 15, he was chargé d'affaires at London 1838, ambassador to Great Britain 1841–4; chancellor of the divan 1845; thrice minister of foreign affairs in the troublous years 1846–52; grand vizier a short time in 1852, but soon displaced as not in political accord with his companions. Recalled as foreign minister during the Crimean war of 1854, in March 1855 he took part in the treaty of the «four guarantees»; in July again became grand vizier, and at the Treaty of Paris in 1856 showed great decision and cleverness in looking after Turkish interests, but without entire success. November 1 his political tone forced him to resign, but he remained minister without portfolio, and member of the Great Council. After Reshid Pasha's death in 1858 he was again grand vizier, and soon again withdrawn; but in November 1861 he resumed the office of foreign minister. He was president of the convention on Rumanian affairs 1864, and member of the Black Sea Conference in London 1871. During the Sultan's absence at the Paris Exposition in 1867 he was regent; and while the very soul of the reform movement energetically suppressed the Cretan rebellion and the movement for Egyptian independence. In the full tide of activity he suddenly died,— an excellent man and statesman who wasted his life trying to vitalize and purify a body of death.

Aar, ar, **Alex,** pseudonym of Anselm Rumpelt, German poet: b. Chemnitz, Saxony, 10 Feb. 1853. His best work was in historical lyrics, collected as 'Will-o'-the-Wisps' (1878).

Aar or **Aare,** ar («river»), the name of several German streams: chiefly, a Swiss river tributary to the Rhine, about 175 m. long, the largest in Switzerland save that and the Rhone. Formed by torrents from the vast and famous Oberaar and Unteraar glaciers of the Bernese Alps in E. Bern, it flows N.W. through the romantic valley of Hasli, over the celebrated Handeck Falls, 200 feet high, expands into Lake Brienz, and then past Interlaken into Lake Thun, becomes navigable, passes Bern, turns N. and then N.E. along the southern slopes of the Jura past Solothurn and Aarau, and, joining the Limmat, shortly after breaks through the ridge and empties into the Rhine at Waldshut. Chief affluents, the Saane, Zihl, and Emme, the Reuss feeding it from the lake of Lucerne and Zuger See, the Limmat from the lake of Zurich, and the Lütschine from the two splendid Grindelwald glaciers.

Aarau, ar'ŏw («Aar-meadow»), Switzerland, capital of Aargau; right bank of the Aar, 41 m. N.E. of Bern, 1,100 ft. above sea-level, in a fertile plain just south of the Jura, whose peaks close by are the Wasserfluh (2,850 ft.) and Giselahfluh (2,540 ft.). It has famous manufactures of cannon, bells, and fine scientific instruments, besides cutlery, leather, silk, and cotton; and holds eight fairs yearly. There are also historic, scientific, and ethnographic museums, a cantonal library of 89,000 volumes rich in Swiss history, and a bronze statue of the historian and novelist Heinrich Zschokke (q.v.), who lived here. Here, December 1797, the old Swiss confederacy held its last session; April to September 1798 it was the capital of the Helvetic Republic. Pop. (1901) 7,824.

Aardvark, ärd'värk (Dutch, «earth-pig»), the Cape ant-eater (*Orycteropus capensis*). Also called ground-hog and ant-bear. A South African mammal measuring about five feet from end of tubular snout to tip of long naked tail. It lives in shallow burrows and is of timid, nocturnal habit; it feeds on ants and other insects, licking them up with a long tongue which secretes a sticky saliva. The head is slightly pig-like, with erect ears; the stout body is sparsely covered with short stiff hairs; the limbs are short, with strong claws for digging; the flesh is edible and considered delicate, though of peculiar flavor. See ANT-EATER.

Aardwolf (Dutch, «earth-wolf»), a timid, nocturnal South African carnivore (*Proteles lalandii*), the only representative of the family *Protelidæ*. It resembles the hyena, to which it is closely related, but has less strength of jaw and teeth. Its fur is coarse; color, ashy-gray irregularly striped with black; muzzle, black and nearly naked; ears, brown outside, gray within. It inhabits burrows, and being unable to kill vertebrates lives upon insects, larvæ, and small carrion.

Aarestrup, Emil, â'rē-stroop, Danish poet (1800–56). He was not duly appreciated until after his death, but is now acknowledged one of the foremost lyric poets of Denmark, ranking next to Christian Winther. His 'Collected Poems,' with critical sketch by G. Brandes, was published at Copenhagen in 1877.

Aargau, ar'gŏw («Aar-shire»: Fr. Argovie, ar-gō-vē), Switzerland, an extreme N. canton between Basel W., Zurich E., Luzern S., and the Rhine and Baden N. Area, 543 sq. m.; capital, Aarau. It consists mainly of spurs of the Alps and Jura, nowhere over 3,000 ft. above sea-level, with numerous fertile valleys watered by the Aar and its S.E. tributaries, the Limmat (or Linth) and Reuss (see AAR) being chief. The climate is moist and variable, and stock-farming and agriculture are advanced: fruit, vegetables, and vines abound, but the wines are inferior. Timber is plentiful. Manufactures: cottons, silks, ribbons, linens, hosiery, straw-plait, etc., and important machine works. The boat traffic on the Aar and Rhine, and the active land and water transit trade, employ

many. It has several picturesque ruined castles. Aargau, part of old Helvetia, then conquered by the Franks (5th century), a Hapsburg fief 1173-1415, then captured by the cantonal league and divided between Bern and Luzern, was split up and a part made a member of the Helvetic Republic 1798. Its constitution was first fixed by the Congress of Vienna in 1815; in 1831 it gained a democratic one, and has ever since been a champion of liberalism. In 1841 it suppressed its eight monasteries, and this led to the formation of the Sonderbund (q.v.), or Secession League, of Catholic cantons in 1847. Legislative power is vested in the Great Council, one for every 1,100 people, which has to submit laws and decrees to a referendum; executive power in the Small Council of seven, chosen by and from the Great one. Pop. (1900) 206,460, nearly all German.

Aarhuus, âr'-hoos, Denmark. (1) District, the E. central part of Jutland, divided into Aarhuus and Randers *amts* (or bailiwicks); area, 1,821 sq. m.; pop. about 325,000, mainly employed in fishing industries. (2) City, the second largest of Denmark, capital of Aarhuus amt, on a bay of the Cattegat and the Danish State Ry.; has a harbor made in 1883–90, with a breakwater and six feet of water, regular steamer lines to Copenhagen and England, and a large trade in grain, cattle, etc.; and much shipbuilding, iron-founding, cotton-spinning, and other manufactures, which are giving it rapid growth. It is a bishop's seat, and has been such since 948, making it one of the oldest cities in Denmark; and its cathedral, begun in 1201, is one of the largest and finest church buildings in the kingdom. It has a museum also. Pop. (1890) 33,306; (1901) 51,909.

Aaron, a prominent but subordinate figure of the Exodus period in Jewish history, whose importance increases with the distance of the recorder from the early epochs, and with the remodeling of the early histories by the priesthood to support their later pretensions and their theocratic ideal of Judaism. In the earliest or Elohistic (q.v.) portions of the Hexateuch, he is brother of Miriam (Ex. xv. 20); but it is Joshua who is Moses' minister for religious rites and who keeps guard over the tent of meeting (Ex. xxiii. 11), the young men of Israel offer sacrifice, and Moses alone is the high-priest. Aaron, however, seems to be regarded as ancestor of one set of priests, those at the Hill of Phinehas, and perhaps of those at Bethel. In a later portion it is he who yields to the demand for an idol, and fashions the golden calf — an evident genealogy of Baal-worship, accredited to the ancestor of rival priests. In the Yahvistic portions he is Moses' older brother, but is brought upon the stage only to be ignored: Pharaoh sends for him and Moses to take away the plagues (Ex. vii.), but he has no independent power and is merely Moses' agent in performing miracles, bringing on plagues, etc. The supererogatory nature of his functions makes it probable that his rôle is introduced by the priestly redactor, under whose hands he becomes a mighty leader little inferior to Moses: he sometimes receives laws directly from Yahwé (Num. xviii.); he with Moses numbers the people; the Israelites rebel against him as well as Moses, though, when he criticises Moses, curiously his inciter Miriam is punished, not himself (Num. xii.); he and Moses jointly disobey Yahwé's command at Meribah; and he is punished by having his life close before entering Canaan. This magnifying connects itself clearly with the post-exilic books, where he is the ancestor of all legitimate priests, consecrated high-priest by Moses, and alone permitted to enter the Holy of Holies yearly: he represents the tribe of Levi, and even within it his descendants alone are rightful priests, and interlopers (see KORAH) are stricken dead by Yahwé. The pre-exilic prophets know nothing of this claim: Ezekiel traces the origin of the Jerusalem priesthood only to Zadok (q.v.). He belongs to the tribe of Joseph and its struggle to secure admission to the Jerusalem priesthood.

Aaron, Hill of, a lofty mountain range of Arabia Petræa, in the district of Sherah or Seir, 15 miles S.W. of Shobeck. On its highest pinnacle — called by the Arabs Nebi Haroun — is a small building supposed by the natives to inclose the tomb of Aaron; and it may be the Mount Hor of Num. xxxiii.

Aaron ben Asher, Jewish scholar: lived in Tiberias early in the 10th century. He completed one of the two existing recensions of the vowels and accents of the Hebrew Bible. His rival Ben Naftali also completed a similar work, but the readings of the former are usually preferred.

Aarsens, Frans Van, är'sens, Dutch diplomat: b. The Hague, 1572; d. 1641. From 26 on he represented the States-General at the court of France for many years, first as agent and then as ambassador; and Richelieu ranked him one of the three greatest politicians of his time. He also held embassies to Venice, Germany, and England. The judicial murder of John of Barneveld by Maurice of Orange in 1619 was greatly helped on by Aarsens, who has gained a tardy popular opprobrium for it through Motley's life of John.

Aasen, Ivar Andreas, â'sen, ē'var än'drā as, Norwegian philologist and poet: b. Örsten, 5 Aug. 1813. At first a botanist, he turned philologist and student of native dialects from patriotic enthusiasm: his great aim was to construct from their older elements a new national language ("Landsmaal"), as a substitute for Danish, in pursuance of which end he published several valuable philological works and set going the nationalistic movement called "maalstrœv." As a poet he produced 'Symra,' a collection of lyrics, and 'Ervingen,' a drama.

Aasvar, âs'-vär, Norwegian islands near the Arctic Circle, where the great Nordland herring are caught in December and January to the extent of sometimes 200,000 tons, and 10,000 men are employed, who live elsewhere the rest of the year.

Aasvogel, äs'fō-gel ("carrion-bird"), the South African vulture, of several different species.

Ab, the 11th month of the Hebrews' civil year and the 5th of their ecclesiastical (which begins with Nisan), has 30 days, and answers to the July moon, or part of our July and August. The 9th day was a great fast in memory

of the destruction of the first temple by Nebuchadrezzar, 586 B.C., and the second by Titus, 70 A.D.

Aba or **Abu Hanifah,** or **Hanfa,** ä'ba or ä'boo hä-nē'fa, or hän'fa, surnamed Alnooma: b. in the 80th and d. in the 150th year of the Hegira (701–771). He is the most celebrated doctor of the orthodox Mussulmans, and his sect is the most esteemed of the four which they severally follow.

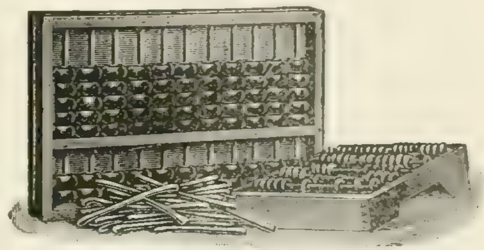
Aba, ä'ba, a mountain in Armenia, part of Mount Taurus, where the rivers Araxes and Euphrates have their rise.

Abab'deh, Abab'de, Abab'idek, or **Hab'ab,** a Hamitic people of E. Africa, descendants of the ancient Nubians, scattered throughout Nubia and between the Nile valley and the Red Sea, but chiefly from 23° N. lat. to the W. border of Lower Egypt. They are small-limbed, but well formed; very dark, but not negroid in features.

Abaco, ä'ba-kō (or **Lucaya**), **Great** and **Little,** two Bahama islands 150 m. W. of Florida. Great Abaco, the largest of the Bahamas, is about 80 m. long by 20 wide, with a lighthouse at its S.E. point, at a natural perforation of the rock known to seamen as "The Hole-in-the-Wall." Little Abaco, 28 m. long, lies W. of its N. point. Area of both, 879 sq. m.; pop. 2,400.

Abacus. In architecture, the flat stone forming the highest member of a column, next under the architrave and bearing its first weight. In the Tuscan, Doric, and Ionic orders, its four sides are arched inward, with generally a rose in the centre. In Gothic architecture it was variously employed, according to the architect's fancy.

Abacus (Greek ἄβαξ, from the Semitic אבק, *abq,* dust). In mathematics, a term applied to several forms of reckoning apparatus, and hence for some centuries to arithmetic itself. The primitive form seems to have been a board covered with fine dust, whence the generic name. Among the Hindus this was a wooden tablet covered with pipe clay, upon which was sprinkled purple sand, the numerals being written with a stylus. (Consult Taylor, in the preface to his translation of the 'Lilawati,' Bombay 1816, p. 6). That this form was used by the ancient Greeks is evident from Iamblichus, who asserts that Pythagoras taught geometry as well as arithmetic upon an abacus. Its use among the Romans of the classical period is also well attested. Another form of the abacus, having many modifications, is a board with beads sliding in grooves or on wires. Herodotus tells us that this instrument was used by the Egyptians and the Greeks, and we have evidence that the Romans also knew it, although preferring a form described below. It is at present widely used, appearing in the form of the *swanpan* in China, the *soroban* in Japan, and the *tschoty* in Russia, the latter being the same as the modern Arabian abacus. It is in this type of the abacus that prayer beads have their origin. The third form is a ruled table, upon which counters are placed, somewhat like checkers on a backgammon board, a game derived from this type of abacus. This was the favorite form among the Romans, whose numerals were not at all adapted to calculation, and it maintained its position throughout the Middle Ages and until the latter part of the 16th century. The Hindu-Arabic numerals (see NUMERALS) having then supplanted the Roman, such an aid to calculation was thought superfluous in western Europe. The counters used were called ψῆφοι by the Greeks, *calculi* (pebbles, whence *calculare* and our *calculate*) by the Romans, and in Cicero's time *aera* because brass discs were used. In mediæval times they were called *projectiles* because they were thrown upon the table, whence our expression to "cast an account," and Shakespeare's "counter caster." The early French



translated this as *gettons, gectoirs,* and *jetons,* whence our obsolete English *jettons* and the modern French *jeton,* meaning a medal, and also a counter for games. The Germans translated the late Latin *denarii supputarii* (calculating pennies) as *Rechenpfennige,* the early printed books distinguishing between reckoning on the line (that is, on the ruled table) and with the pen. The Court of the Exchequer (q.v.) derives its name from this form of the abacus, about which the judges of the fiscal court sat. (Hall, 'The Antiquities and Curiosities of the Exchequer,' London 1891; Henderson, 'Select Historical Documents of the Middle Ages,' London 1892, p. 20.) Another form of the abacus, possibly introduced by Gerbert before he became Pope Sylvester II. (q.v.), was arranged in columns and employed counters upon which the western Arab forms of the Hindu numerals (see NUMERALS) were written. The use of the term to designate an instrument of calculation led to its use for arithmetic itself, as in the 'Liber abaci' of Leonardo Fibonacci of Pisa (q.v.) and in the works of later writers.

Consult: Knott, 'The Abacus,' in the 'Transactions of the Asiatic Society of Japan,' Vol. XIV.; Bayley, in the 'Journal of the Royal Asiatic Society' (N. S.), Vol. XV.; Chasles, in the 'Comptes rendus,' t. 16, 1843, p. 1409; Woepcke, in the 'Journal asiatique,' 6 ser., t. 1. See FINGER NOTATION.

DAVID EUGENE SMITH,
Professor of Mathematics, Teachers College, Columbia University, New York.

Abad' ("abode"), a suffix meaning town or city, common in Hindu and Persian names: as Allahabad, city of God; Hyderabad, city of Hyder; Secunderabad, city of Alexander.

Abad'don, in the Old Testament and the rabbinical literature, Sheol, the underworld, or the place of the lost in it: in Revelation (ix. 11) the King of the Abyss, Greek APOLLYON.

Ab'adir, according to Augustine the chief god of the Carthaginians; according to Priscian, a stone which Saturn swallowed by contrivance of his wife Ops, believing it to be his new-born

son Jupiter, and hence worshipped with divine honors.

Abakansk', a mountain range in Siberia, extending from the upper Yenisei to the Tom R., parallel to the Altai Mts. Also a town founded by Peter the Great in 1707, near the Abakan River; now renamed Minusinsk (q.v.).

Ab'alo'ne (Sp., origin unknown). Any one of the several species of *Haliotis* (ear-shells or sea-ears) found along the California coast. The shell is a spiral so broadly flattened as to make an oval saucer, around the edge of which is a row of holes through which the tentacles pass when extended. The animal lives on rocks near the shore, feeding on seaweed; when frightened it withdraws entirely beneath its shell and clings with surprising force to the rock. The shell is lined with a bright mother-of-pearl much used in arts and crafts. The animal itself is used as food by the Chinese and Japanese; quantities of them are dried and exported from California to the Orient. The name "abalone" is local, but marine gastropods of the same family are abundant in all seas not too cold, outside the western Atlantic. See HALIOTIDÆ; SEA-EAR.

Abanah, ä-bä'nä, or **Amanah** (Gr. Chrysorrhoas, now Baradá, "The cold"), one of the two famous "rivers of Damascus" mentioned in the Scripture: rising in the heart of the Anti-Lebanon, it flows through a narrow gorge and spreads fan-wise through the Damascus oasis, irrigating the land and supplying the city, by the canals or "rivers," with its clear sparkling water, so greatly superior to the Jordan in beauty that Naaman's question is quite intelligible.

Abancay, ä-bän-kī', Peru, capital of dept. Apurimas, 65 m. W. of Cuzco, on the Abancay, an affluent of the upper Apurimac; in an East-Andean valley, the best sugar district in Peru, with large refineries and silver mines. Pop. (1889) 3,000.

Abandonment, the act of abandoning, giving up, or relinquishing.

In commerce it is the relinquishment of an interest or claim. Thus, in certain circumstances, a person who has insured property on board a ship may relinquish to the insurers a remnant of it saved from a wreck, as a preliminary to calling upon them to pay the full amount of the insurance effected.

The principle is also applicable in fire insurance, and often under stipulations in life policies in favor of creditors. The chief object of abandonment being to recover the whole value of the subject of the insurance, it is necessary only where the subject itself, or portions of it, or claims on account of it, survive the peril which caused the loss. At once upon receiving information of a loss the assured must elect whether to abandon, and not delay for the purpose of speculating on the state of the markets.

The English law is more restricted than the American, by not making the loss over half the value conclusive of the right to abandon, and by judging the right to abandon by the circumstances at the time of action brought, and not by the facts existing at the time of the abandonment. By commencing full repairs the right of abandonment is waived. An abandonment may be oral or in writing. When acted upon by another party, the effect of abandonment is to devest all the owner's rights.

Abano, Pietro di, ä'ba-nō, pēä'trō dē, known also as Petrus de Apono, one of the most celebrated physicians of the 13th century: b. in the Italian village from which he takes his name, in 1240 or 1250; d. 1316. He visited the East in order to acquire a thorough knowledge of Greek, and then completed his studies at the University of Paris. Returning to Italy he settled at Padua, where his reputation as a physician became so great that his rivals, envious of his fame, gave out that he was aided in his cures by evil spirits. It was known, too, that he practised astrology, and he was twice summoned before the Inquisition. On the first occasion he was acquitted, and he died before his second trial came to an end. Besides the work, 'Conciliator Differentiarum Philosophorum et Præcipue Medicorum' (Mantua, 1472), he wrote 'De Venenis eorumque Remediis' (1472), 'Geomantia,' 'Quæstiones de Febribus,' and other works.

Abano, Italy (Lat. "Fontes Aponi"), lies at the foot of the Vicentine Hills, in Lombardy. Its noted springs, much visited by invalids, were well known to the ancients, and are referred to by Martial and Claudian.

Aban'tes, an ancient Greek people originally from Thrace, who settled in Phocis, and built a town called Abæ. Their name implies an ancestor or leader Abas.

Abar'banel. See ABRABANEL.

Ab'arim ("the beyonds," sc. Jordan), the edge of the Moabite plateau overlooking the entire Jordan valley: a range of highlands forming its whole horizon, broken only by the valley mouths of the Yarmuk, the Zerka, and the Jabbok. Its highest elevation is Mount Nebo, whence Moses had his "Pisgah view" of Palestine (see PISGAH), and whence Jericho is plainly visible. Ancient altars, perhaps Amorite, were discovered here in 1881.

Ab'aris, the Hyperborean (fabled as from the Caucasus or thereabout), a legendary sage first mentioned by Pindar and Herodotus, 5th century B.C., but quite uncertain of date or existence. He had the prophetic gift, and a magic arrow of Apollo on which he rode through the air; cured by incantations, rid the world of a great plague, etc. The Neo-Platonists made him Pythagoras' companion.

Abascal, José Fernando, ä-bäs-cäl', hō-sā' fĕr-nän'dō, Spanish soldier and statesman: b. Oviedo, 1743; d. Madrid, 1821. Entering service in 1762, he rose to brigadier-general in the French Revolutionary wars; in 1796 became viceroy of Cuba and defended Havana against the English fleet; then was commander in New Galicia, and later viceroy of Peru, where he showed great ability and kindliness, and in recognition of his efforts to reconcile natives and Spanish was created Marqués de la Concordia. He defended Buenos Ayres from the English, and suppressed revolts in Lima and Cuzco; but having a turn of ill success was recalled in 1816.

Abasolo, Mariano, ä-bä-sō'lō, mä-rē-ä'-nō, Mexican patriot: b. in Guanajuato about 1780; d. Cadiz, 1819. Joining Hidalgo's (q.v.) Mexican revolution in 1810, he rose to major-general, and was noted for humanity to prisoners. After the final rout at the Calderon bridge, 17 Jan. 1811, he fled with his chief; with him was captured by the counter-revolutionists, tried, and

sentenced to life imprisonment in Spain, where he died.

Abatement. In law: (1) A removal or putting down, as of a nuisance. (2) A quashing; a judicial defeat; the rendering abortive by law, as when a writ is overthrown by some fatal exception taken to it in court. A plea designed to effect this result is called a plea in abatement. All dilatory pleas are considered pleas in abatement, in contradistinction to pleas in bar, which consider the merits of the claim. (3) Forcible entry of a stranger into an inheritance when the person seized of it dies, and before the heir or devisee can take possession. (4) The termination of an action in a court of law, or the suspension of proceedings in a suit in equity, in consequence of the occurrence of some event, as for example the death of one of the litigants. In contracts, a reduction made by the creditor in consideration of the prompt payment of a debt due by the debtor. In mercantile law, a deduction from duties imposed at the custom-house, on account of damages received by goods during importation or while in the custom-house.

A misnomer of plaintiff or defendant can be taken advantage of only by plea in abatement.

In heraldry, an abatement was formerly an addition to a coat-of-arms, indicative of disgrace or inferiority; now it is confined to the bend sinister, marking illegitimate descent.

Ab'atis, or **Abattis,** in military affairs, a defense made of felled trees. In sudden emergencies, the trees are merely laid lengthwise beside each other, with the branches pointed outward to prevent the approach of the enemy. When employed for the defense of a pass or entrance, the boughs of the trees are stripped of their leaves and pointed, the trunks are planted in the ground, and the branches interwoven with each other; and the abatis is laid in a depression in front of a trench, for protection from artillery fire.

Ab'atos, Egypt, an island in Lake Mœris, famous as the sepulchre of Osiris, and for producing the papyrus of which the ancients made their paper.

Abattoir (Fr.), ab-at-war, a slaughter-house; sometimes extended to include a great market of which the abattoir proper is only a part. The nuisance of blood, offal, etc., in crowded settlements, early forced ancient civilized governments to put the slaughter of the animals under restrictions. Our first definite information on this point is the system under the Roman empire: the slaughter-houses instead of being scattered about the streets were collected in one quarter, forming the public market, which in Nero's time was one of the most imposing structures in Rome. The system was introduced into Gaul, but the meat supply of Paris was in the hands of a clique of aristocratic families who balked all attempts at reform; and though as far back as 1567 Charles IX. had issued a decree on the subject, no improvement was made till Napoleon's time, when the nuisance was shocking,—slaughter-houses abutted on the principal thoroughfares, herds of footsore and lamenting beasts impeded traffic, the gutters ran with blood, offal poisoned the air, and the Seine was a sewer for it. A commission was appointed to rectify these conditions in 1810, and the five great abattoirs which still exist were formally opened 15 Sept. 1818. They have been the models of the world, and for many years had no rivals; indeed, for symmetry of arrangement they have never been surpassed. But of late the vast American establishments near Chicago, at Brighton, Mass., and other places, have carried speed, economy, and cleanliness to an ideal point, and American inventiveness has built up an incredible number of subsidiary industries and products, so that literally not a hair of an animal's body nor a drop of its blood is wasted: foods, medicines, chemicals, manures, building-materials, etc., produced from the refuse of the slaughter-houses are past numbering.

Abauzit, Firmin, ab-ō-zē, fēr-mañ, French scholar of Arabian blood and Protestant parents: b. Uzès, 1679; d. Geneva, 1767. He lost his father when only two; in 1685, on the Revocation, the authorities tried to tutor him for a Catholic, but his mother contrived his flight with an elder brother to the Cevennes, where after two years as fugitives they gained Geneva, and the mother escaped from imprisonment and joined them. He early acquired great proficiency in languages, physics, and theology; traveled to Holland and made acquaintance with Bayle and others, and to England, where Newton admired him greatly, corrected through him an error in his "Principia," and wrote to him, "You are well worthy to judge between Leibnitz and me." William III. wished him to settle in England, but he preferred to return to Geneva: assisted a society there in translating the New Testament into French, was offered but refused a chair in the University, but accepted a sinecure librarianship, and died very aged. He was of wonderful versatility and universality, seeming to have made everything a speciality; Rousseau, jealous of every one, yet eulogized him warmly; and Voltaire asked a flattering stranger who said he had come to see a genius, whether he had seen Abauzit. His heirs, through theological differences, destroyed his papers, so that little remains of his work; he wrote articles, however, for Rousseau's 'Dictionary of Music' and other works, and edited with valuable additions Spon's 'History of Geneva.' (Collected works, Geneva, 1770; London, 1773. Translations by Dr. Harwood, 1770, 1774. For personal information, see Senebier's 'Histoire Littéraire de Genève'; Harwood's 'Miscellanies'; Orme's 'Bibliotheca Biblica,' 1834.)

Abba, Giuseppe Cesare, joo-sep'ā chā-zä'-ra, Italian poet: b. 1838 at Cairo Montenotte. He took part in the expedition of Garibaldi into Sicily in 1860, which he celebrated in his poem 'Arrigo.' Among his other works are a tragedy, 'Spartaco,' a historical novel, and lyric poems.

Abba (same as papa, etc.), Aramaic form of Hebrew for "father." In the New Testament, used as an address to God; in the Talmud, a scholar's title of honor; also used as part of proper names; and at present the title of Syriac, Coptic, and Ethiopic bishops. See PAPA; POPE.

Abbadie, Antoine Thomson and **Arnaud Michel d',** dab-ad-ē, äñ-twan toñ-soñ (and ar-nō mē-shel, brothers and explorers: b. in Dublin, Ireland, 3 Jan. 1810 and 24 July 1815 respectively. In 1837–48 they explored Abyssinia and Upper Egypt, traveled up the White Nile, visited Darfur (regarded by the English

in these places as French emissaries), and made a remarkably large collection of Ethiopic and Amharic manuscripts. Among other works Antoine published 'Geodesy of Part of Upper Ethiopia' (1860–73) and 'Dictionary of the Amarin Language' (1881); and Arnaud, 'Twelve Years in Upper Ethiopia' (1868).

Abbadie, Jacques, ab-ad-ē, zhak, or **James,** eminent French-English divine: b. Nay, Bern, c. 1654–7; d. London, 1727. A poor boy, educated by friends, he took a degree of doctor in theology at Sedan at 17, was minister of a French Protestant church in Berlin some years, then in 1688 accompanied Marshal Schomberg to London for the second English Revolution, and became minister of the French church in the Savoy. He was strongly attached to William's cause, wrote an elaborate defense of it, and a history of the conspiracy of 1696 from materials furnished by the government; and William made him dean of Killaloe, Ireland. A very able man and eloquent preacher, Abbadie is best known by his religious treatises in French, several of them translated into other languages: the most important are that 'On the Truth of the Christian Religion,' with its sequel 'On the Divinity of Jesus Christ,' and 'The Art of Self-Knowledge.

Abbas (IBN ABD IL MUTTALIB, 'bn äbd il moo-ta'lib), uncle of Mohammed; at first hostile to him, but ultimately — after the defeat at Bed'r (see MOHAMMED) — the chief promoter of his religion. He was the founder of the Abbasside (q.v.) caliphate at Bagdad.

Abbas I., of Persia, "the Great," 7th shah of the Sufi dynasty: b. 1567, acceded 1585: d. 27 Jan. 1628. Sent to Khorasan as nominal governor in childhood, at 18 he was proclaimed shah by its nobles, smarting under the oppression of his father Mohammed Khodabendeh's officers; the father was soon driven from the throne. At this time the Turks had invaded the western Persian provinces, and the Uzbek Tartars occupied and ravaged Khorasan. Abbas first transferred his residence from Kasbin to Ispahan; he then by treaty confirmed to the Turks all their conquests, to gain time for chastising the Uzbeks, whom in 1597 he surprised and routed near Herat, and followed this by the conquest of Ghilan, Mazanderan, much of Tartary, and nearly all Afghanistan. He then declared war against the Turks; and in 1605, with 60,000 men, annihilated their army of nearly double the number at Basra, Bussorah), recovering all the lost provinces, and not only securing complete immunity from Turkish aggression for the rest of his life, but extending his empire beyond the Euphrates. In 1611 he dictated to Achmet I. a treaty which gave Persia Shirwan and Kurdistan. In 1618 he routed the united Turkish and Tartar armies near Sultanieh, securing more territory; and on the Turks renewing the war in 1623 he captured Bagdad after a year's siege. The same year he took Ormuz from the Portuguese; and when he died his dominions reached from the Tigris to the Indus. His internal administration was no less firm and beneficial. He encouraged commerce, built highways, repressed violence, and left the country flourishing as it never has since. He was favorable to foreigners, and two Englishmen, Sir Anthony and Sir Robert Shirley, had much influence over him. He was like Herod in every respect: a jealous and cruel tyrant to his family,— he slew his eldest son and blinded his other children,— his country alone felt his good side.

Abbas-Mirza, a Persian prince and warrior, favorite son of the shah Feth-Ali: b. 1783; d. 1833. He was early convinced of the advantages of Western civilization, and with the help of European officers he first of all applied himself to the reform of the army. He led the Persian armies with great bravery, but with little success, in the war with Russia ended by the peace of Gulistan, when Persia lost her remaining Caucasus districts and ceded to Russia the sovereignty of the Caspian; and in that of 1826–8, ended by the peace of Turkmanchai, when she lost most of Persian Armenia. In 1829 he visited St. Petersburg, to ward off punishment for the murder of the Russian ambassador in a riot at Teheran; and was sent back to Persia loaded with presents. His eldest son acceded to the throne in 1834.

Abbas Pasha I., viceroy of Egypt, grandson of the famous Mehemet Ali: b. 1813; d. 13 July 1854. Early initiated into public life, in 1841 he took an active part in his grandfather's Syrian war; in 1848 the death of his uncle Ibrahim Pasha called him to the viceregal throne at Cairo. During his brief reign he did much to undo the progress made under Mehemet Ali: he dismissed all Europeans and fought Western ideas energetically. At the outbreak of the Crimean war he placed 15,000 men and his fleet at the Sultan's disposal; but was shortly after found dead, not without suspicion of foul play.

Abbas Pasha II., Hilmi, hēl'mē, khedive of Egypt, eldest son of the khedive Tewfik: b. 1874: studied at Vienna: on his father's death in 1892 became khedive. He won popularity by reducing the taxes, and tried to throw off the English influence. In 1893 he dismissed four of his ministers, but Lord Cromer interfered and he agreed to follow England's recommendations in all important matters. See also NUBAR PASHA.

Abbassides, abăs'sīdz, **The,** 750–1517, caliphs at Bagdad and later in Egypt; nominal sovereigns of all Islam, but losing Spain at the outset, and never practically obeyed in Africa outside Egypt; the most famous dynasty of Saracen sovereigns. They took their name from Abbas (q.v.), the uncle of Mohammed. This descent had given the family great influence by a century after the Prophet's death; and Ibrahim, fourth in descent from Abbas, had gained several victories over the Ommiads (q.v.), supported by the province of Khorasan, when the Ommiad caliph Merwan defeated and put him to death in 747. His brother Abu 'l-Abbas, whom he had named his heir, assumed the title of caliph, crushed the Ommiad dynasty in a decisive battle near the Zab (750) and acceded to their position. Its members and relatives were nearly all tolled into one spot and exterminated, earning for Abu 'l-Abbas the nickname of As-Saffah, "the butcher"; but one of them, Abd-er-Rahman (q.v.), escaped, and after picturesque adventures set up an independent emirate in Spain, which toward two centuries later took the title of caliphate. On Abu 'l-Abbas' death, his successor Al-Mansur r moved the seat of royalty to Bagdad, and w successes against Turkomans and Greeks in Asia Minor; but by this time the warlike impulse had

begun to decay, and the love of luxury and its literary and artistic attendants to come to the front. Means were found of evading the strictness of Mohammedan rules; and no courts of any age or country were gayer or more splendid than those of the great Harun al-Rashid, Charlemagne's contemporary (786–809), and Al-Mamun (813–833). The splendor of their palaces, their decorations, their equipages, and the seemingly exhaustless treasures they possessed, gave them a world-wide celebrity — especially in contrast with the poverty-stricken barrenness and barbarism of most Christian sovereigns at that period — which is vivid even yet in literature and popular memory: Harun is the chief princely figure of the 'Arabian Nights,' and Bagdad the center of all picturesque and varied enjoyment. Al-Mamun is still more honorably remembered as the patron of arts and literature. What lay underneath this external gorgeousness — the corruption, the furies of jealousy and bloodshed, and the barbarous oppression of the many — is outside a notice like this. But external decay soon began to witness internal rottenness. The Ashlabites, Edrisites, etc., carved out independent sovereignties in Africa; the Taherites in 820 set up a separate power in Khorasan, even under the great Al-Mamun. The Greeks, under the new life of the Byzantine empire brought in by Leo the Isaurian (q.v.), pushed them back in Asia Minor; and Al-Mamun's last years were contemporary with the philosopher, soldier, and statesman, the all-accomplished Emperor Theophilus. But the final stroke came from barbarians. The caliph Motassem (833–842), who had fought both Theophilus and the hordes of Turkestan successfully, distrusting his subjects, formed body-guards out of his Turkish prisoners. They soon became what the Roman prætorians were — masters of the empire. Motassem's son Motawakkel was assassinated by them in his palace (861) and the succeeding caliphs were their puppets; and in 936 the caliph Radhi (934–41) was forced to give up the command of the army and other powers to his general and mayor of the palace, Mohammed ben Rayek. The provinces one after another threw off allegiance; the caliph held only Bagdad and its neighborhood; and at last Hulagu, prince of the Mongols, fired Bagdad and slew the reigning caliph Motassem in 1258. The Abbassides retained a nominal caliphate in Egypt under the ægis of the Mamelukes, and never gave up the claim or the hope of their old position and seat; but in 1517 the Turkish Sultan Selim I., the conqueror of Egypt, bore the last of them, Motawakkel III., a prisoner to Constantinople, finally allowing him to return to Egypt, where he died a Turkish pensioner in 1538. (Muir's 'Caliphate' for the best English account; the monumental treasure-house of information for scholars is Weil's great 'Geschichte der Chalifen,' 1846–62.)

Abbate, āb-ä'te, or **Abati,** ä-bä'tē, **Nicolo,** nē'kō-lō, Italian painter, follower of Raphael and Corregio: b. 1512 at Modena, where his earlier works are exhibited; d. 1571 at Fontainebleau — his frescoes in which palace are his best-known productions. His finest piece, however, is regarded as 'The Adoration of the Shepherds,' at Bologna, where his later work re[illegible]stly exists. He has another in the Dresden gallery.

Abbe, Cleveland, American meteorologist: b. New York city, 3 Dec. 1838. Graduated 1857 at the Free Academy (now College of the City of New York); studied astronomy at Ann Arbor with Brünnow and at Cambridge with Gould (1858–64); resided at Pulkova observatory, Russia, 1864–6; director Cincinnati Observatory 1868–73, where he began the system of co-ordinated daily weather forecasts which led to the United States establishing the same system and in 1870 calling Prof. Abbe to Washington to direct it, making him professor of meteorology in the Weather Bureau. May 1879 he initiated the movement toward standard time (q.v.) and hour meridians. January 1873 he started the 'Monthly Weather Review,' of which he has remained editor. He is professor of meteorology in Columbia University, Washington, lecturer on the same at Johns Hopkins, etc. Among his publications are a work on 'Meteorological Apparatus and Methods' (1887); 'Studies for Methods in Storm and Weather Predictions (1889); 'Mechanics of the Earth's Atmosphere' (1891), 'Solar Spots and Terrestrial Temperature,' and 'Atmospheric Radiation.'

Ab'be, Ernst, German physicist: b. Eisenach, 1840; d. Jena, 1905. Studied at Jena and Gottingen; became assistant at the latter's observatory, and lecturer before the Frankfort-on-the-Main Physical Society; 1863–70 lecturer at Jena, and 1870 professor there; 1878 director of its observatories; in 1891 he resigned professorship. He became distinguished for his work in perfecting optical instruments, especially photograph and microscope lenses, having for a long time been connected with the highly reputed firm of Carl Zeiss in Jena. He invented the Abbe refractometer. He wrote a work in German on the 'Refracting and Dispersing Power of Solid and Fluid Bodies.'

Abbe, ab-ā, originally the French name for an abbot, but later used in the general sense of a priest or clergyman. By a concordat between Pope Leo X. and Francis I. in 1516, the French king had the right to nominate upward of 200 *abbés commendataires*, who drew a third of the revenues of the monasteries without having any duty to perform. They were not necessarily clergy, but were expected to take orders unless exempted by a dispensation. The hope of obtaining one of those sinecures led multitudes of young men, many of them of noble birth, to enter the clerical career, which however seldom went further than taking the inferior orders; and it became customary to call such aspirant abbés, jocularly, Abbés of St. Hope. They formed a considerable and influential class in society; and an abbé, distinguished by a short violet-colored robe, was often found as chaplain or tutor in noble households, or engaged in literary work. This class of nominal clergy disappeared at the Revolution. In Italy they are called *abbate*.

Abbess, the female superior of some convents of nuns, corresponding to the abbot over monks. She was elected from the monastery by secret votes, inducted by a bishop's consecration, and held office three years or even for life unless deprived for misconduct. The Council of Trent fixed the required age at 40, with 8 years of professed membership in the monastery. She could discipline and even expel the nuns, subject to the bishop; but, being a female, could

exercise only certain functions, such as giving religious counsel and administering the rule, but no spiritual jurisdiction, as ordaining, conferring the veil, or excommunicating.

Abbeville, France, ab-vēl ("abbey-town," of St. Riquier's), capital of Abbeville arrondissement, dept. Somme; on both banks of the Somme and an island in it, 12 m. from its mouth and head of navigation (at high tide vessels of 150 to 200 tons can reach it) connected by canals with Amiens (25 m. distant), Lille, Paris, and Belgium; on the Northern Ry. It is an old, narrow-streeted, picturesque town, with strong fortifications on Vauban's system; has a wonderfully fine church of the flamboyant order, St. Wolfran's, begun under Louis XII. (1462–1515), a very interesting city hall built in 1209, and a library of 1690 now containing 45,000 volumes. It manufactures jewelry, soaps, glassware, and various fabrics, as velvets, cottons, linens, etc. But its chief interest to the foreign world is for the relics and implements of primitive man (the cave-dweller) and the fossils of extinct animals found there. Pop. (1896) 17,781.

Abbeville, S. C., county seat of Abbeville co.; on the Southern and Seaboard A. L. R.R.'s; 106 m. W. of Columbia. It is in a rich cotton-growing region; is noted for its fine climate, which makes it a popular resort for Northern invalids, and has a national bank, excellent public schools, several large manufactories connected with the cotton industry, flour and feed mills, brick-yards, etc. Property valuation over $500,000; bonded debt less than $55,000. There are several periodicals. Pop. (1890) 1,696; (1900) 3,766.

Abbeville Treaties. (1) A treaty in 1259 between Louis IX. of France ("St. Louis") and Henry III. of England, to settle definitely the territorial rights of the two crowns, Louis fearing that his title to some possessions was liable to dispute, and having sought a settlement for many years. It was negotiated at Paris with Simon de Montfort, Earl of Leicester, and signed by the two kings at Abbeville during Henry's visit to France, 1259–60, but dated back to 20 May 1259. Henry resigned all title to Normandy, Maine, Anjou, Touraine, and North Saintonge; Louis turned over Périgord, Limousin, South Saintonge, and some districts south of the Loire, to be held by Henry in fief,— a surrender which so enraged the inhabitants that they refused to celebrate Louis' birthday. Henry resigned the titles of Duke of Normandy and Count of Anjou, and agreed to do homage at Paris for those of Duke of Guienne and peer of France. (2) Between Henry VIII. and Francis I. in 1527, Wolsey representing England.

Abbey, Edwin Austin, American artist: b. Philadelphia, 3 April 1852; studied at the Pennsylvania Academy of Fine Arts; lived in New York and drew illustrations of a high order for periodicals, also painting water-colors, till 1883, when he removed to England. His two most individual qualities have been his love for English country life and scenery and for the old English poets and dramatists, both of which have resulted in notable illustrations (as of Shakespeare, Goldsmith, etc.) and paintings; and his ability as a colorist, though much of his work has been done without color. He has also deep intellectual and spiritual qualities; and all these faculties and tastes together combine in the famous panels of the 'Search for the Holy Grail' on the upper walls of the delivery room at the Boston Public Library. He was elected member of the Royal Academy July 1898; was one of the American jurors on paintings in the Paris Exposition of 1900; and was commissioned by Edward VII. to paint the coronation scene in Westminster Abbey. (See Radcliffe's 'Schools and Masters of Painting,' 1898; Müther's History of Modern Painting,' 1896.)

Abbey, Henry, poet and journalist: b. Rondout, N. Y., 11 July 1842. He has published several collections of pleasing verse: (May Dreams' (1862); 'Ralph, and Other Poems' (1866); 'Ballads of Good Deeds' (1872); 'Collected Works' (1885; 3d ed. 1895); 'Phaeton' (1901).

Abbey, Henry Eugene, American operatic manager: b. Akron, O., 27 June 1846; d. 1896. He was engaged for several years in theatrical, and from 1883 in operatic management, producing Italian and German operas with the most distinguished singers of the day.

Abbey, a monastery or religious community of the highest class, governed by an abbot, assisted generally by a prior, sub-prior, and other subordinate functionaries; or, in the case of a female community, superintended by an abbess. A priory differed from an abbey only in being on a smaller scale, and governed by a superior named a prior. Abbeys or monasteries first rose in the East. Among the most famous abbeys on the European continent were those of Clugny, Clairvaux, and Citeaux in France; of St. Galle in Switzerland, and of Fulda in Germany; in England, those of Westminster, St. Mary's of York, Fountains, Kirkstall, Tintern, Rievaulx, Netley, Paisley, and Arbroath. The English abbeys were wholly abolished by Henry VIII. at the Reformation. Abbeys were usually strongly built, with walls which served as a defense against enemies and within which were large buildings in which the occupants carried on the work to which they had been assigned. See Abbot; Monastery.

Abbitib'bi, a river, a lake, and a former important trading-post of the Hudson Bay Company in the Northwest Territories of Canada. The river is the outlet of the lake, about 49° N. lat., and flows into James Bay; the post is on the shore of the lake.

Abbo of Fleury, flė-rē, French theologian; b. near Orléans about 945; d. 1004. He studied at Rheims and Paris; acquiring great repute as a scholar and scientist (of the time), Oswald, Archbishop of York, induced him to teach for two years in the abbey of Ramsey and aid in restoring the monastic system; on his return to France he became abbot of Fleury and built up a thriving school there; was sent by Robert II. (son of Hugh Capet) on two missions to Rome, 986 and 996, and each time succeeded in warding off a papal interdict. Later, while trying to reform the discipline of the priory of La Réole, Gascony, he was killed. He wrote lives of the early popes down to Gregory I. (Life by his pupil Aimoin, in Latin, 'Vita Abbonis abbatis Floriacensis.')

Abbot, Ezra, American Biblical scholar: b. Jackson, Me., 28 April 1819; d. 21 March 1884.

He studied at Phillips Exeter Academy, graduated at Bowdoin 1840, and after teaching in Maine and Cambridge, Mass., became in 1856 assistant librarian of Harvard. In 1872 he received a D.D. from Harvard, though a layman, and thence till death was professor of New Testament criticism and interpretation in the Cambridge Divinity School. His wide reading and wonderful verbal memory made him one of the foremost of textual critics and bibliographers; his mastery of the Greek New Testament text placed him beside the leading scholars of the world; and on the American New Testament Revision Committee, 1871-81, he was a chief agent in putting its work on an even level of authority with the English, in minute accuracy of scholarship as well as broad, acute judgment. Indifferent to fame, he gave his best work to collaborations or private assistance mostly unacknowledged and unrealized except by scholars. His most important individual book was on the 'Authorship of the Fourth Gospel' (1880), in which he announced the important discovery of Tatian's 'Diatessaron.' Of his other critical work, besides the great Revision, his half of the prolegomena to Tischendorf's Greek New Testament (1884-94), his additions to Mitchell's 'Critical Handbook of the New Testament' (1880), and his revision of Schaff's 'Companion to the New Testament' (1883), should be mentioned. As a bibliographer, his greatest fame was for the curious and exhaustive catalogue of relevant books he furnished for Alger's 'Critical History of a Future Life' (1864), and his notes to Smith's 'Bible Dictionary' (Am. ed. 1867-70). He also wrote many papers for periodicals.

Abbot, Francis Ellingwood, American religious radical: b. Boston, 1836; graduated at Harvard 1859, and Meadville (Pa.) Theological School 1863. A Unitarian minister 1863-8, he started in 1870 *The Index,* an ultra-radical weekly devoted to religious and philosophical topics; and wrote 'Scientific Theism' (1886), and 'The Way Out of Agnosticism' (1890), besides notable magazine articles.

Abbot, George, Archbishop of Canterbury: b. Guildford, Surrey, 19 Oct. 1562; d. 5 Aug. 1633. A cloth-worker's son, he studied at Balliol, Oxford, was chosen Master of University College 1597, and three times was vice-chancellor of Oxford. Dr. Abbot's name was second on the list of eight divines ordered in 1604 to prepare the present (King James) version of the Bible. In 1608 he went to Scotland with the Earl of Dunbar to arrange for a union of the English and Scotch churches. James took a great fancy to him, and, though Abbot had never held a parish, made him bishop of Lichfield and Coventry in 1609, transferred him to the see of London a month later, and less than a year afterward appointed him Archbishop of Canterbury. Flattery of the king is accredited as the cause of this astonishing rapidity of preferment; but once in his seat, at least, Abbot felt no need of such tactics. He opposed the scandalous divorce suit of Lady Frances Howard against the Earl of Essex, though the court favored and carried it. In 1618 he forbade the reading, in the Croydon church where he was, of the king's declaration permitting games and sports on Sunday, which the Puritans (to whom Abbot belonged) regarded as a permit to break the Sabbath, and the order to read it as a command to commit blasphemy. He promoted the marriage between the Princess Elizabeth and the Protestant Elector Palatine, and opposed the disastrous Spanish-marriage project of Prince Charles, and thereby won Charles', Laud's, and Buckingham's hatred. The king, however, remained his friend. In 1622 he accidentally killed a keeper while deer-hunting, and his enemies tried to have him disqualified for the involuntary manslaughter. The king made light of the matter, but had to refer it to a commission, which decided in his favor, and he was formally absolved and reappointed. He attended James in his last sickness, and crowned Charles. The latter, on Abbot's refusing to license a fanatical divine-right sermon, deprived him of his functions and put them in commission; but, having to summon a parliament shortly after, was afraid of the effect and restored him. From that time he lived in retirement, leaving Laud in complete ascendancy. He wrote many works now forgotten, though one on the prophet Jonah was reprinted in 1845. A geography passed through numerous editions.

Abbot, Henry Larcom, American military engineer: b. Beverly, Mass., 13 Aug. 1831; graduated at West Point 1854; entered the engineer corps. He took part in the survey for a Pacific railroad and of the Mississippi River delta. He served through the Civil War as engineer and artillerist, was wounded at Bull Run, and commanded the siege artillery before Richmond, an account of which he published in 1867. He became colonel and chief of engineers, and was brevetted brigadier-general U. S. Vols., and major-general U. S. Army. He long commanded the engineers' garrison at Willett's Point, N. Y., established an engineers' school, worked out and laid down the submarine defenses of New York harbor, and accomplished much in the improvement of mortar batteries and engineering equipment, etc.; was a member of the Gun Foundry Board and the Board of Fortifications and Defense, of that for the protection of the Mississippi basin, of that on the proposed canal from Pittsburg to Lake Erie, and of the technicay Committee of the new Panama Canal Co. He drew the plans for the harbor at Manitowoc, Wis. He was retired in 1895. He is a member of many scientific societies, including the National Academy of Sciences; and has written, besides many reports of boards and committees and the work above cited, a volume on submarine mines for harbor defense (1881), and, in collaboration, 'Physics and Hydraulics of the Mississippi.'

Abbot, Joseph Hale, American educator: b. Wilton, N. H., 26 Sept. 1802; d. 7 April 1873. Graduated at Bowdoin 1822, tutor there 1825-7; professor of mathematics Phillips Exeter Academy 1827-33; then taught a ladies' school in Boston; subsequently was principal of the Beverly, Mass., high school. He was for some years recording secretary of the American Academy of Arts and Sciences, and published valuable scientific papers in its 'Transactions,' besides writing on pneumatic and hydraulic problems, in which he made ingenious investigations. He was associate editor of Worcester's Dictionary.

Abbot, Samuel, American philanthropist: b. Andover, Mass., 25 Feb. 1732; d. 12 April 1812. He became a wealthy Boston merchant and gave $20,000 in 1807 toward founding Andover Seminary, with $100,000 more by will.

Abbot ("father"), originally the head and ruler of a community of monks; in the Greek Church *hegumenos*, «leader,» or archimandrite, «ruler of the fold,» though the latter is oftener an abbot-general with *hegumenoi* under him. Among the Dominicans the head of a convent was called *præpositus*, a «provost,» or *prior;* among the Franciscans *custos*, «guardian»; among the Camaldules *major*. The term «abbot» originated in the East, and was first applied to any monk noted for piety, but at length restricted to the superior. The first abbots were laymen like the rest of the monks in general; the lowest clergy took precedence of them, and for sacraments they had to attend the nearest church: but the extreme inconvenience or even impossibility of this when the monastery was in a desert or far from a town forced the ordination of the abbots. Abbots could attend councils, and the second Council of Nice, 787, allowed them to ordain monks to the inferior orders; and ultimately nearly all monks were ordained to some grade of the ministry. To this elevation was added that of allowing pluralities of abbacies, originally forbidden, and even in the 6th century allowed only in special cases; but it increased till early in the 10th century one German prelate had twelve abbeys under him, corresponding to the archimandrites of the East. Thus, and by the increase of numbers and corporate wealth in the great abbeys, the abbots themselves became prelates of vast power. Still another cause developed this,— the exemption of abbeys from control of the bishops. They were originally all subject to episcopal jurisdiction, and in the West generally continued so till the 11th century; this is expressly ordered in Justinian's code. The exactions of the bishops, however, rendered the exemption increasingly frequent; beginning in 456 the practice grew, and was much helped forward by Gregory the Great, who relieved many abbots from episcopal control and made them responsible directly to the Pope. By the 12th century this had become an evil of the first order in ecclesiastical government, the bishop usually having no authority whatever over the chief centres of religious and often secular power in his diocese; and one abbot, of Fulda in Germany, claimed precedence over the Archbishop of Cologne. Next came an encroachment on the functions of the bishops: from conferring the tonsure and the office of reader they came to be equally associated with the bishops in consecrations; and while originally the bishop chose the abbot from the monks of the house, and then the right of election was transferred to the monks, the abbots came sometimes to choose their own successors. This, however, was stopped in some countries by a counter-process; the popes in Italy and the kings in France assuming to themselves the right of appointment.

Otherwhere the choice was by secret election of and from the monks of the house, unless it furnished no fit candidate, when choice might be made from another monastery of one well instructed himself and competent to instruct others, of legitimate birth and at least 25 years old. His election was for life. His power was absolute except as restricted by the canons of the Church. His exaction of deference in the routine of life was royal: all rose and bowed when he entered the church or chapter, his letters and orders were received kneeling, and no monk could sit in his presence or leave it without permission. They had immense political power, and were on equal terms of intimacy with the greatest in the realm. Many of the abbots were an honor to their countries, and their schools were seminaries of learning and virtue.

In time the title was improperly conferred on others who had no connection with monastic life, or sometimes even with the Church,— on the principal of a body of parochial clergy or the king's chaplain, and the chief magistrate of Genoa was called «Abbot of the People.» Lay abbots, so called, originated in temporarily handing over the revenues of an abbey to some noble, or even the king, for a great public exigency, the noble being titular abbot, but enough of the revenues being reserved from sequestration to support the house. Once in lay hands they usually remained there, and most of the Frankish and Burgundian sovereigns and chief nobles in the 9th and 10th centuries were titular abbots of great monasteries, whose revenues they applied to their own uses. This often happened from the monastery's voluntarily placing itself under the «commendation» of some noble for protection; and there were sometimes two lines of abbots,— one lay, taking the major part of the income without service, the other clerical, doing the work. This was mostly reformed during the latter part of the 10th century.

In convent cathedrals, where the bishop filled the place of the abbot, the superior's duties were performed by a prior. In other convents the prior was the vice-abbot. The superiors of cells, or small monastic establishments dependent on the larger ones, were also called priors; they were appointed by the abbot and held office at his pleasure. (H. J. Feazey's 'Monasticism'; Montalembert's 'Monks of the West,' ed. 1896, Vol. I.; Bingham's 'Origines'; Martene's 'Rites of the Ancient Monasteries.')

Abbot, The, by Sir Walter Scott. A sequel to 'The Monastery,' but dealing with more stirring situations. The time of the action is 1567–68. While the action goes on partly at Avenel Castle, and Halbert Glendinning of 'The Monastery,' as well as his brother Edward (now an abbot) figure prominently in the story, the reader finds that he has exchanged the humble events of the little border vale by Melrose for thrilling and romantic adventures at Lochleven Castle on its island in the lake, north of Edinburgh, where Mary Queen of Scots is imprisoned. The chief interest centres around the unfortunate queen. The framework of the tale it is claimed is historically true.

Abbotsford, a fording-place of the Tweed near its confluence with the Yarrow; the name given by Sir Walter Scott to his property there bought in 1811, in memory of its use by the monks of Melrose Abbey, it being at the time known as the Clarty [Filthy] Hole. The site is

a low hillside on the southern bank, overlooked by the Selkirks. At first only a villa, now the west wing of the pile, he was seized with the idea of founding a great feudal family of the old Scotch pattern, with this for a baronial seat; and gradually added other sections, copying old Scotch mansions or ruins, or special features of them, making an irregular, rambling, picturesque abode, «a romance in stone and lime.» It now belongs to the Hope-Scotts, descendants of Scott's daughter and Lockhart.

Abbott, Alexander Crever, American hygienist: b. Baltimore, Md., 26 Feb. 1860. He was educated at Johns Hopkins University and at the universities of Maryland, Munich, and Berlin. He is a fellow of the College of Physicians in Philadelphia, and a member of numerous scientific societies; in 1900 was professor of hygiene and director of the laboratory of hygiene in the University of Pennsylvania. His publications include ‹The Principles of Bacteriology,› and numerous papers on bacteriology and hygiene.

Abbott, Austin, LL.D., American law-writer, son of Jacob: b. Boston, 18 Dec. 1831; d. 1896. He was graduated at the University of the City of New York in 1851, and entered the practice of law; collaborated with his brother Benjamin in valuable legal compilations, digests, text-books, etc.; was an able law lecturer, and dean of his alma mater's law school 1891-6. He was counsel for Theodore Tilton in the Beecher trial. With his brothers Benjamin and Lyman he wrote two novels, ‹Cone Cut Corners› (1855) and ‹Matthew Caraby› (1858).

Abbott, Benjamin, revivalist: b. Long Island 1732; d. Salem, N. J., 14 Aug. 1796. A hatter's and then a farmer's apprentice, somewhat dissipated but a kind husband and father and a church-goer (whence his accounts of the pit from which he was rescued are probably dialectic), he was roused to intense conviction of sin at 33 by an itinerant Methodist preacher, joined that Church with his children and his Presbyterian wife, and became one of the most remarkable revivalists of the time, producing wonderful conversions of the most hardened, and often sending hearers into convulsions. In the Revolution the Methodists were suspected of disloyalty, and more than once he was near being mobbed; but he always preached down his assailants, once turning from their purpose a gang of a hundred soldiers. Serving for 16 years as a local preacher, from 1789 he went on various circuits, and in 1793 was made an elder and sent to Maryland. He carried on his duties till death despite much enfeeblement; and his career has been one of the most stirring themes for exhortation in the Church.

Abbott, Benjamin Vaughan, American lawyer, eldest son of Jacob: b. 4 June 1830; d. 1890. He was graduated at the University of the City of New York in 1850, and practised law with his brothers Austin and Lyman. He compiled nearly 100 volumes of legal digests and reports. He drew up in 1865, as secretary of the New York Code Commission, the penal code which is the basis of the present one. In 1870 President Grant appointed him one of three commissioners to revise the United States statutes, which occupied three years, and compressed 16 volumes into one large octavo; thence till 1879 he was occupied on a great revision of the ‹United States Digest.› Among his lesser works are ‹Judge and Jury› (1880), collected contributions to periodicals; a Chautauqua book, ‹The Traveling Law School›; and ‹Famous Trials› (1880).

Abbott, Charles Conrad, author and naturalist: b. Trenton, N. J., 4 June 1843. He received an academical education, and took the degree of M.D. at the University of Pennsylvania in 1865. His life is devoted wholly to scientific and literary pursuits. He is corresponding member Boston Society of Natural History; member American Philosophical Society of Philadelphia; Fellow Royal Society of Antiquaries of North, Copenhagen; Assistant, Peabody Museum of American Archæology and Ethnology, Cambridge, Mass., 1876-89. Author: ‹Primitive Industry› (1881); ‹Naturalist Rambles about Home› (1884); ‹Upland and Meadow› (1886); ‹Waste-land Wanderings› (1887); ‹Days Out of Doors› (1889); ‹Outings at Odd Times› (1890); ‹Recent Rambles› (1892); ‹Travels in a Tree-top› (1894); ‹The Birds About Us› (1894); ‹Notes of the Night› (1895); ‹A Colonial Wooing› (novel, 1895); ‹Birdland Echoes› (1896); ‹When the Century was New› (novel, 1897); ‹The Hermit of Nottingham› (novel, 1897); ‹The Freedom of the Fields› (1898); ‹Clear Skies and Cloudy› (1899); ‹In Nature's Realm› (1900); Report on Indian Stone Implements, in ‹American Naturalist› (1872), revised and enlarged as ‹Stone Age in New Jersey,› in Smithsonian Annual Report of 1876. In 1876 he announced the discovery, since confirmed by other archæologists, of traces of man in the Delaware River valley, dating from at least the close of the glacial period.

Abbott, Edward, D.D., American clergyman, son of Jacob: b. Farmington, Me., 15 July 1841. He was graduated at the University of the City of New York 1860, and at Andover Theological Seminary 1862; in 1863 was with the United States Sanitary Commission at Washington and in the field. The same year he was ordained Congregational clergyman, and 1865-9 was pastor of the Pilgrim Church, Cambridge, Mass.; in 1879 he was ordained Episcopal priest and ever since has been rector of St. James', Cambridge; in 1889 he was elected missionary bishop of Japan, but declined. He was associate editor of the ‹Congregationalist› 1869-78, and editor of the ‹Literary World› 1878-88, and again from 1895. Among his works are ‹Conversations of Jesus› (1875); ‹Paragraph History of the United States› (1875); ‹Paragraph History of the American Revolution› (1876); ‹Long Look Series,› juvenile (1877-80); memorial of his father (1882); and ‹Phillips Brooks› (1900).

Abbott, Edwin Abbott, English theologian and Shakespearean scholar: b. London, 20 Dec. 1838; graduated at St. John's College, Cambridge; senior classic and Chancellor's medalist (1861). He was master at King Edward's School, Birmingham, 1862-4, and at Clifton College; and head-master of the City of London School, 1865-89, raising it to a foremost rank in England. In the latter year he retired. He has been select preacher at Cambridge and Oxford. His works include the well-known ‹Shake-

spearean Grammar› (1869, enlarged 1870), still a classic; ‹Bacon and Essex› (1877); ‹Philochristus› (1878), and ‹Onesimus› (1882), two anonymous romances of the first age of the Church; ‹Francis Bacon› (1885); ‹Anglican Career of Cardinal Newman› (1892); ‹St. Thomas of Canterbury› (1898); volumes of sermons, and other religious works.

Abbott, Emma (Wetherell), one of the foremost of American dramatic sopranos: b. Chicago, Ill., December, 1849; d. Salt Lake City, 5 Jan. 1891. Beginning in Plymouth Church choir, Brooklyn, N. Y., she studied abroad with Sangiovanni at Milan and with Delled Sedie, Wartel, and James at Paris; then joined Mapleson's troupe, made her début at Covent Garden, London, toured three years in Great Britain, and returning to the United States spent her remaining years there, the later ones with the Emma Abbott English Opera Company. In 1878 she married E. J. Wetherell of New York.

Abbott, Frank Frost, American Latinist: b. Redding, Conn., 27 March 1860; graduated at Yale 1882; Latin tutor at Yale 1885–91; associate professor 1892; 1894 professor of Latin in the University of Chicago. He has written ‹Repetition in Latin› (1900), a ‹History of Roman Political Institutions› (1901), and philological work.

Abbott, Gorham Dummer, American educator, brother of Jacob and J. S. C.: b. Hallowell, Me., 3 Sept. 1807; d. 31 July 1874. He graduated at Bowdoin 1826, at Andover 1831. Ordained a Congregational clergyman, he became a teacher in New York; in 1845 with his brothers he established the Abbott Institute for females in New York city and in 1847 the Spingler Institute,— pioneers in women's higher education; the latter held a foremost rank in the United States for thirty years, and he left it in 1869 a rich man. He wrote didactic works, as ‹The Family at Home,› ‹Nathan W. Dickerman,› ‹Pleasure and Profit›; also ‹Mexico and the United States.›

Abbott, Jacob, a famous American juvenile writer and educator: b. Hallowell, Me., 14 Nov. 1803; d. 31 Oct. 1879. He graduated at Bowdoin 1820, studied at Andover, and was ordained a Congregational minister; professor of mathematics and natural philosophy at Amherst 1825–9; then established the Mt. Vernon girls' school in Boston, and in 1834 organized and was pastor of the Eliot Church in Roxbury. In 1839 he removed permanently to Farmington, Me., and devoted himself to literary work there and in New York, assisting also in female education (see the preceding title), writing extensively for the early ‹Harper's Monthly,› of which he was one of the chief bulwarks, traveling widely abroad, and writing the classic juveniles of which the ‹Rollo Books› are the best known type,— neither their usefulness, their popularity, nor their charm, has yet vanished. He had an excellent dramatic sense, a healthy balance, a sound business practicality and a true understanding of and sincere sympathy with children, which makes his didactics charming to rightly constituted children; no boys and girls were ever less priggish than those in ‹Rollo,› the conventional burlesques of which merely prove that the authors have not read the books, and even so are a testimony to their vitality. The chief of his more than 200 volumes are the ‹Rollo Books,› (28 vols.), the ‹Lucy Books› (6 vols.), the ‹Jonas Books› (6 vols.), the ‹Franconia Stories› (10 vols.), the ‹Marco Paul Series› (6 vols.), the ‹Gay Family› series (12 vols.), the ‹Juno Books› (6 vols.), the ‹Rainbow Series› (5 vols.), and several other series of science and travel for the young; more than 20 of the series of illustrated histories to which his brother J. S. C. contributed, and 8 vols. of American history. He also edited historical text-books and compiled school readers.

Abbott, Sir John Joseph Caldwell, Canadian statesman: b. St. Andrews, Quebec, 12 March 1821; d. 1893. Graduated at McGill College, Montreal, he became a lawyer, and was regarded among the best Canadian authorities on commercial law, being dean of the McGill College Law Faculty for ten years. In 1859 he was elected to the Lower House of Quebec, representing Argenteuil till the union of the Provinces in 1867, when he was returned to the Canadian House of Commons. In 1862 he was solicitor-general in the Sandfield Macdonald-Sicotte Cabinet. In 1887 he joined Sir John A. Macdonald's Cabinet as minister without portfolio, and on Macdonald's death in June 1891 was made premier of the Dominion; but resigned from ill health November 1892, accepting a seat without portfolio in the Cabinet of his successor, Sir John Thomson.

Abbott, John Stephens Cabot, American author: b. Brunswick, Me., 18 Sept. 1805; d. Fairhaven, Conn., 17 June 1877. He graduated at Bowdoin 1825, and Andover; was ordained Congregational minister 1830, and held pastorates at Worcester, Roxbury, and Nantucket, Mass. He resigned the ministry in 1844 and devoted himself to popular literature. A fertile writer like his brother Jacob, and with an interest in his own matter that gave a certain charm to his style and excited equal interest in uncritical readers, but with too little acumen and too much rhetoric for the solid historical subjects he had a passion for, he issued very many works useful in stimulating public curiosity in history, but of too little weight to endure. The most famous was the ‹Life of Napoleon› contributed as a serial to ‹Harper's Magazine,› and a great popular success; others were ‹The French Revolution,› ‹Napoleon at St. Helena,› ‹The Civil War in America› (1863–6), ‹Napoleon III.› (1868), ‹Romance of Spanish History› (1879), ‹Frederick the Great› (1871), and many volumes of small histories and biographies.

Abbott, Lyman, American clergyman and editor, third son of Jacob: b. Roxbury, Mass., 18 Dec. 1835. He graduated at the University of the City of New York in 1853; studied law, and went into partnership with his brothers Austin and Benjamin in 1856; but feeling more bent for the ministry studied theology with his uncle John S. C., and was ordained 1860. Till 1865 he was pastor at Terre Haute, Ind.; 1865–8 secretary of the Freedmen's Commission, residing in New York, also becoming pastor of the New England Church there; in 1869 resigned his pastorate for journalism and literature. He was in succession editor of the «Literary Record» department of ‹Harper's Magazine,› and at the same time chief editor of the ‹Illustrated Christian Weekly›; then associ-

ate editor with Henry Ward Beecher of the ‹Christian Union,› now the ‹Outlook,› of which he became chief editor on Mr. Beecher's death in 1887, succeeding him also in the Plymouth Church pulpit, which he resigned in 1899 to devote himself wholly to literary work. His earliest books were two novels in collaboration with his brothers (see ABBOTT, AUSTIN). He has written a ‹Life of Jesus› (1869), ‹Old Testament Shadows of New Testament Truths› (1870), ‹A Dictionary of Bible Knowledge› and ‹A Layman's Story› (1872), ‹Commentary on the New Testament› (4 vols., 1875 sq.), ‹Life of Henry Ward Beecher› (1883), ‹Evolution of Christianity› (1892), ‹Christianity and Social Problems› (1896), ‹The Theology of an Evolutionist› (1897), ‹Life and Letters of Paul› (1898), ‹Life and Literature of the Ancient Hebrews' (1901), 'The Rights of Man' (1901), 'Personality of God' (1905), etc.; besides editing volumes of Beecher's sermons and devotional exercises from his writings.

Abbott, Russell Bigelow, D.D., American educator: b. Brookville, Ind., 8 Aug. 1823; graduated at the University of Indiana 1847. After several years as principal of public schools in Muncie and New Castle, Ind., and of Whitewater Presbyterian Academy, he was ordained in the Presbyterian Church, 1857; held pastorates in Indiana and Minnesota 24 years, 15 in Albert Lea, Minn.; and founding Albert Lea College there became its president in 1884. Dr. Abbott has been a leading force in his Church body.

Abbreviations or «shortenings» are used in writing to save time and space, or it may be to ensure secrecy. The ancient copiers of MSS. invented many contractions to facilitate their labor. Greek MSS. abound in such, and hence often cannot be read without a previous regular study of Greek palæography. From MSS. these contractions were transferred to the printed editions of Greek authors, and have only been wholly disused within the past century; hence regular lists of them were given in the earlier Greek grammars, because the knowledge of them was absolutely essential to the student. Some of the commoner are still given in some grammars, as many Greek works are accessible only in editions full of them. Among the Romans the marks of abbreviation, called *notæ* or *compendia scribendi*, were so numerous that, in a classification by L. Annæus Seneca, they amount to 5,000. With the Latin language the ancient Roman abbreviations passed to the Middle Ages, appearing first on inscriptions and coins, then in manuscripts, and, more especially after the 11th century, in charters and other legal documents. The use of them in legal documents was forbidden by an act of Parliament passed in the reign of George II. In the following list most of the abbreviations that are likely to be met with by modern readers are alphabetically arranged, save chemical elements, for which see table of ATOMIC WEIGHTS. The standard abbreviations used in library catalogues are also given. (For Latin abbreviations see Campelli's ‹Dizionario di Abbreviature›: Milan, 1899).

A.— Acre; Acting; Accept.
A: (Lib. cat.).— Augustus.
A.. (Lib. cat.).— Anna.
A. or Ans.— Answer.
A. A.— Associate of Arts.
A. A. A. G.— Acting Assistant Adjutant-General.
A. A. A. S.— American Association for the Advancement of Science.
A. A. G.— Assistant Adjutant-General.
A. A. P. S.— American Association for the Promotion of Science.
A. A. S.— *Academiæ Americanæ Socius,* Fellow of the American Academy (of Arts and Sciences).
A. A. S. S.— *Americanæ Antiquarianæ Societatis Socius,* Member of the American Antiquarian Society.
A. B.— Able-bodied seaman; *Artium Baccalaureus,* Bachelor of Arts.
A. B. C. F. M.— American Board of Commissioners for Foreign Missions.
Abl.— Ablative.
Abp.— Archbishop.
Abr.— Abridgment, or Abridged.
A. B. S.— American Bible Society.
a/c — Account.
A. C.— *Ante Christum,* before the birth of Christ; Arch-chancellor.
Acad.— Academy.
Acad. Nat. Sci.— Academy of Natural Sciences.
Acc.— Accusative.
Acct.— Account.
A. C. S.— American Colonization Society.
Act.— Active; Acting.
Ad.— Advertisement.
A. D.— *Anno Domini,* in the year of the Lord.
A. D. C.— Aide-de-camp.
Adj.— Adjective.
Adjt.— Adjutant.
Adjt.-Gen.— Adjutant-General.
Ad lib.— *Ad libitum,* at pleasure.
Adm.—Admiral; Admiralty.
Adm. Co.— Admiralty Court.
Admr.— Administrator.
Admx.— Administratrix.
Ads.— *Ad sectam,* at the suit [of].
Ad v.— *Ad valorem,* at (or on) the value.
Advt.— Advertisement.
A. E. I. O. U. (The Austrian device) — *Austriæ est imperare orbi universo,* or *Alles Erdreich Ist Öesterreich Unterthan,* «It is given to Austria to rule the whole earth."
Æt.— *Ætatis,* of age; aged.
A. F. B. S.— American and Foreign Bible Society.
Afr.— African.
A. G.— Adjutant-General.
Agl. Dept.— Agricultural Department (Department of Agriculture).
Agr.—Agriculture.
A. G. S. S.— American Geographical and Statistical Society.
Agt.— Agent.
A. H.— *Anno Hegiræ,* in the year of the Hegira (Mohammedan era).
A. H. M. S.— American Home Missionary Society.
Ala.— Alabama.
Alas.— Alaska.
Alb.— Albany.
Alban.— Albanian.
Ald.— Alderman.
Alex.— Alexander.
Alf.— Alfred.
Alg.— Algebra.
Alt.— Altitude.

Am.— American; Amos.
A. M.— *Ante meridiem*, before noon; morning; *Anno mundi*, in the year of the world; *Artium Magister*, Master of Arts.
Am. Ass. Adv. Sci.— American Association for the Advancement of Science.
Amb.— Ambassador.
Amer.— American.
Amer. Acad.— American Academy.
A. M. E. Z.— African Methodist Episcopal Zion.
Amm.— *Amalgama*, amalgamation.
Amt.— Amount.
An.— *Anno*, in the year.
A. N. A.— Associate of the National Academy.
An. A. C.— *Anno ante Christum*, in the year before Christ.
Anal.— Analysis.
Anat.— Anatomy.
Anc.— Ancient; anciently.
And.— Andrew.
Ang.-Sax.— Anglo-Saxon.
Ann.— *Annales*, annals.
Anon.— Anonymous.
Ans.— Answer.
Ant., or Antiq.— Antiquities.
Anth.— Anthony.
Aor.— Aorist.
A. O. S. S.— *Americanæ Orientalis Societatis Socius*, Member of the American Oriental Society.
Ap.— Apostle; Appius; *Apud*, in writings of; as quoted by.
Apo.— Apogee.
Apoc.— Apocalypse.
Apocr.— Apocrypha.
App.— Appendix.
Apr.— April.
Aq.— *Aqua*, water.
A. Q. M.— Assistant Quartermaster.
A. Q. M. G.— Assistant Quartermaster-General.
A. R.— *Anna Regina*, Queen Anne; *Anno regni*, in the year of the reign.
Ara.— Arabic.
A. R. A.— Associate of the Royal Academy.
Arch.— Archibald; Architect; Architecture.
Archd.— Archdeacon.
Arg.— *Arguendo*, in arguing, or in the course of argument; *argumento*, by an argument drawn from such a law.
Ari.— Arizona.
Arith.— Arithmetic.
Ark.— Arkansas.
Arm.— Armenian.
Armor.— Armoric.
Arr.— Arrive; Arrival.
A. R. R.— *Anno regni regis*, in the year of the reign of the king.
A. R. S. A.— Associate of the Royal Scottish Academy.
A. R. S. S.— *Antiquariorum Regiæ Societatis Socius*, Fellow of the Royal Society of Antiquaries.
Art.— Article.
Artil.—Artillery.
A.-S.— Anglo-Saxon.
A. S., or Assist. Sec.— Assistant-Secretary.
A. S. A.—American Statistical Association.
Ass., Assn.— Association.
A. S. S. U.— American Sunday-School Union.
Astrol.—Astrology.
Astron.—Astronomy.
At s.—At suit of.
A. T. S.— American Tract Society.
Atty.— Attorney.
Atty.-Gen.— Attorney-General.
At. Wt.— Atomic weight.
A. U. A.— American Unitarian Association.
A. U. C.— *Anno urbis conditæ*, or *ab urbe condita*, in the year from the building of the city (Rome).
Aug.— August.
Aus.— Austria; Austrian.
Auth. Ver., or A. V.— Authorized Version (of the Bible).
Av.— Avenue; Average; Avoirdupois.
Ave.— Avenue.
Avdp. or Avoir.— Avoirdupois.
A. Y. M.— Ancient York Masons.

B.— Born.
B: (Lib. cat.).— Benjamin.
B.. (Lib. cat.).— Beatrice.
B. A.— Bachelor of Arts.
Bal.— Balance.
Balt.— Baltimore.
B. & F.— Beaumont and Fletcher.
Bapt.— Baptist.
Bar.— Barometer; Baruch.
Bart.— Baronet.
Bbl.— Barrel.
B. C.— Before Christ; British Columbia.
B. C. L.— Bachelor of Civil Law.
B. D.— *Baccalaureus Divinitatis*, Bachelor of Divinity.
Bdls.— Bundles.
Bds.— Boards; Bonds.
Beau. & Fl.— Beaumont and Fletcher.
Beds.— Bedfordshire.
Belg.— Belgic; Belgian; Belgium.
Benj.— Benjamin.
Berks.— Berkshire.
B. I.— British India.
Bib.—Bible; Biblical.
Bibliog.— Bibliographical; Bibliography.
Biog.—Biography; Biographical.
Bisc.— Biscayan.
B. Jon.— Ben Jonson.
Bk.— Bark; Book.
B. LL.— *Baccalaureus Legum*, Bachelor of Laws.
Bls.— Bales.
B. M.— *Baccalaureus Medicinæ*, Bachelor of Medicine.
Bohem.— Bohemian
Bost.— Boston.
Bot.— Botany.
Bp.— Bishop.
Br.— Brig; British; Brother.
B. R.—*Banco Regis*, or *Reginæ*, the King's or Queen's Bench.
Braz.— Brazil; Brazilian.
Brig.— Brigade; Brigadier.
Brig.-Gen.— Brigadier-General.
Brit. Mus.— British Museum.
Bro.— Brother.
B. S.— Bachelor in the Sciences.
Bt.— Baronet.
Bu.— Bushel; Bushels.
Bucks.— Buckinghamshire.
Burl.— Burlesque.
B. V.— *Beata Virgo*, Blessed Virgin; *Bene vale*, farewell.
Bx., Bxs.—Box; Boxes.

C.— *Caput* or *capitulum*, chapter; Celsius; Cent; Centigrade; Cents; *Centum*, a hundred; Century; *Circa* or *circiter*, about; Consul.
C: (Lib. cat.).— Charles.

C.. (Lib. cat.).— Charlotte.
Ca. (*circa*)— About.
C. A.— Chief Accountant; Commissioner of Accounts.
Cæt. par.— *Cæteris paribus*, other things being equal.
Cal.—California; Calends.
Cam., Camb.— Cambridge.
Can.— Canon.
Cant.— Canticles.
Cantab.— *Cantabrigiæ, Cantabrigiensis*, of Cambridge.
Cantuar.— *Cantuariæ, Cantuariensis*, of Canterbury.
Cap.— *Caput, capitulum*, chapter.
Caps.— Capitals.
Capt.— Captain.
Capt.-Gen.— Captain-General.
Car.— Carat.
Card.— Cardinal.
Ca. resp.— *Capias ad respondendum*, that you take to answer,— a legal writ.
Cas.— Cases.
Ca. sa.— *Capias ad satisfaciendum*, that you take to satisfaction,— a legal writ.
Cash.—Cashier.
Cat.— Catalogue.
Cath.— Catherine, Catholic, Cathedral.
C. B.— Cape Breton; *Communis Bancus*, Common Bench; Companion of the Bath.
C. C.— Caius College; *Compte courante*, account current; Circuit Court; County Commissioner; County Court; Cubic centimeter.
C. C. C.— Corpus Christi College.
C. C. P.— Court of Common Pleas.
C. E.— Civil Engineer.
Cel., or Celt.— Celtic.
Cels.— Celsius.
Cent.— Centigrade, a scale of 100° from freezing to boiling; Central; *Centum*, a hundred; Century.
Cert.— Certify.
Certif.—Certificate.
Cf.— *Confer*, compare.
C. f. & i.— Cost, freight, and insurance.
C. G.— Commissary-General; Consul-General.
C. G. H.— Cape of Good Hope.
Ch.— Chapter; Charles; Chief; China; Chinese; Church.
C. H.— Court house.
Chal. or Chald.— Chaldaic; Chaldea; Chaldean; Chaldron.
Chanc.— Chancellor.
Chap.— Chapter.
Chas.— Charles.
Chem.— Chemistry.
Ches.— Chesapeake.
Chic.— Chicago.
Ch. J.— Chief Justice.
Chr.— Christ; Christian; Christopher; Chronicles.
Chron.— Chronicles.
Cic.— Cicero.
Cin.— Cincinnati.
Circ.— *Circa*, or *circiter*, about; Circuit.
Cit.— Citation; Cited; Citizen.
Civ.— Civil.
C. J.— Chief Justice.
Cld.— Cleared.
Clk.— Clerk.
C. M.— Common Meter.
C. M. G.— Companion of the Order of St. Michael and St. George.

Co.— Company; county.
Coch., or Cochl.— *Cochlear*, a spoonful. *C. amp.* (*amplum*), a tablespoonful. *C. mag.* (*magnum*), a large spoonful. *C. med.* (*medium*), a dessert-spoonful. *C. parv.* (*parvum*), a small spoonful or teaspoonful.
C. O. D.— Cash (or collect) on delivery.
Col.— Colorado; Colonel; Colossians.
Coll.— Collector; Colloquial; College; Collection.
Colo.— Colorado.
Com.— Commerce; Committee; Commissioner; Commodore.
Comdg.— Commanding.
Comm.— Commentary.
Comp.— Compare; Comparative; Compound; Compounded.
Com. Ver.—Common Version (of the Bible).
Con.— *Contra*, against; in opposition.
Conch.— Conchology.
Con. Cr.— Contra credit.
Confed.— Confederate.
Cong.— Congress.
Congl.— Congregational; Conglomerate.
Conj.— Conjunction.
Conn., or Ct.— Connecticut.
Con. Sec.— Conic sections.
Const.— Constable; Constitution.
Cont.— Continued; contra.
Cop., or Copt.— Coptic.
Cor.— Corinthians.
Cor. Mem.—Corresponding Member.
Corn.— Cornwall; Cornish.
Corol.— Corollary.
Cor. Sec.— Corresponding Secretary.
Cos.— Cosine.
Coss.— *Consules*, Consuls.
Cp.— Compare.
C. P.— Common Pleas; Court of Probate.
C. P. S.— *Custos Privati Sigilli*, Keeper of the Privy Seal.
Cr.— Credit; Creditor; Criminal.
C. R.— *Carolus Rex*, King Charles; *Custos Rotulorum*, Keeper of the Rolls.
Crim. Con.— Criminal conversation (adultery).
C. S.— Court of Sessions; *Custos Sigilli*, Keeper of the Seal.
C. S. A.—Confederate States of America; Confederate States Army.
Csk.— Cask.
C. S. N.— Confederate States Navy.
C. Theod.— *Codice Theodosiano*, in the Theodosian Code.
Ct.— Connecticut; Court.
Ctl.— Cental.
Cts.— Cents.
Cu., or Cub.— Cubic.
Cur.— Currency.
Curt.— Current.
C. W.—Canada West.
Cwt.— Hundredweight.
Cyc.— Cyclopedia.

D.— Day; Days; *Denarius*, penny, pence; Died
D: (Lib. cat.).— David.
D.. (Lib. cat.).— Delia.
D. A. G.— Deputy Adjutant-General.
Dak.—Dakota.
Dan.— Daniel; Danish.
Dat.— Dative.
D. B. or Domesd. B.—Domesday Book.
D. C.— *Da capo*, again; District of Columbia.
D. C. L.—Doctor of Civil Law.

D. C. S.—Deputy Clerk of Sessions.
D. D.—*Divinitatis Doctor*, Doctor of Divinity.
D. D. S.—Doctor of Dental Surgery.
Dea.—Deacon.
Dec.—December; Declination.
Dec. of Ind.—Declaration of Independence.
Def.—Definition.
Def., Deft.—Defendant.
Deg.—Degree; degrees.
Del.—Delaware; Delegate; *Delineavit*, he (or she) drew it.
Dem.—Democrat; Democratic.
Dep.—Deputy.
Dept.—Department.
Deut.—Deuteronomy.
D. F.—Defender of the Faith.
D. G.—*Dei gratia*, by the grace of God; *Deo gratias*, thanks to God.
D. H.—Dead-head.
Diam.—Diameter.
Dict.—Dictionary; Dictator.
Dim.—Diminutive.
Diosc.—Dioscorides.
Disc.—Discount.
Diss.—Dissertation.
Dist.—District.
Div.—Division.
D. L. O.—Dead-Letter Office.
D. M.—Doctor of Music.
Do.—*Ditto*, the same.
Doc.—Document.
Dols.—Dollars.
D. O. M.—*Deo optimo maximo*, to God, the best, the greatest.
Doz.—Dozen.
D. P.—Doctor of Philosophy.
Dpt.—Department.
Dr.—Debtor; Doctor; Drachms.
D. S.—*Dal segno*, from the sign.
D. Sc.—Doctor of Science.
D. T.—*Delirium tremens; Doctor Theologiæ*, Doctor of Theology.
Dub.—Dublin.
D. V.—*Deo volente*, God willing.
Dwt.—Pennyweight.
Dyn.—Dynamics.

E.—East.
E: (Lib. cat.).—Edward.
E.. (Lib. cat.).—Elizabeth.
Ea.—Each.
E. & O. E.—Errors and omissions excepted.
E. B.—English Bible.
Eben.—Ebenezer.
Ebor.—*Eboracum*, York.
Eccl.—Ecclesiastes.
Ecclus.—Ecclesiasticus.
Ed.—Editor; Edition.
E. D.—Eastern District.
Edin.—Edinburgh.
Edm.—Edmund.
Edw.—Edward.
E. E.—Errors excepted.
E. E. T. S.—Early English Text Society.
E. Fl.—Ells Flemish.
E. Fr.—Ells French.
E. G.—*Exempli gratia*, for example; *Ex grege*, among the rest.
E. I.—East Indies or East India.
E. I. C. S.—East India Company's Service.
Eliz.—Elizabeth.
E. Lon.—East longitude.
E. M.—Mining Engineer.
Emp.—Emperor; Empress.
Encyc.—Encyclopedia.
Encyc. Amer.—Encyclopedia Americana.
E.N.E.—East-northeast.
Eng.—Engineering; Engineers; England; English.
Ent., Entom.—Entomology.
Env. Ext.—Envoy Extraordinary.
Eod.—Every other day.
Eow.—Every other week.
Ep.—Epistle.
Eph.—Ephesians; Ephraim
Epis.—Episcopal.
E. S.—Ells Scotch.
Esd.—Esdras.
E.S.E.—East-southeast.
Esq.—Esquire.
Esth.—Esther.
E. T.—English Translation.
Et al.—*Et alii*, and others.
Etc., or &c.—*Et cæteri, et cæteræ, et cætera*, and others; and so forth.
Eth.—Ethiopic; Ethiopian.
Et seq.—*Et sequentes, et sequentia*, and what follows.
Etym.—Etymological; Etymology.
E. U.—*États Unis*, United States; Evangelical Union.
Ex.—Example; Exodus.
Exc.—Excellency; exception.
Exch.—Exchequer; Exchange.
Ex. Doc.—Executive Document.
Exec.—Executive; Executor.
Execx.—Executrix.
Ex. gr.—*Exempli gratia*, for example.
Exon.—*Exonia*, Exeter; *Exoniæ, Exoniensis*, of Exeter.
Ex p.—*Ex parte*, in behalf of.
Exr.—Executor.
Ez.—Ezra.
Ezek.—Ezekiel.

F.—Fahrenheit; Farthing; Fathom; Fathoms; Forte; Franc; France; Francs; French; Friday.
F: (Lib. cat.).—Frederick.
F.. (Lib. cat.).—Fanny.
Fahr.—Fahrenheit.
F. and A. M.—Free and Accepted Masons.
F. A. S.—Fellow of the Antiquarian Society.
F. B. S.—Fellow of the Botanical Society.
F. C.—Free Church of Scotland.
Fcap. or fcp.—Foolscap.
F. C. P. S.—Fellow of the Cambridge Philological Society.
F. C. S.—Fellow of the Chemical Society.
F. D.—*Fidei Defendor*, Defender of the Faith.
F. E.—Flemish ells.
Feb.—February.
Fec.—*Fecit*, he did or made it.
Fed.—Federal.
Fem.—Feminine.
F. E. S.—Fellow of the Entomological Society; Fellow of the Ethnographical Society.
Ff.—*Fecerunt*, they did or made it; Folios; Following; Fortissimo.
F. F. V.—First Families of Virginia.
F. G. S.—Fellow of the Geological Society.
F. H. S.—Fellow of the Horticultural Society.
Fid. Def.—*Fidei Defendor*, Defender of the Faith.
Fi. fa.—*Fieri facias*, that you cause to be done or made,—a writ of execution.

Fig.— Figure.
Fin.— Finland.
Finn.— Finnish.
Fir.— Firkin.
F. K. Q. C. P. I.— Fellow of King's and Queen's College of Physicians, Ireland.
Fl.— Florin; Florins; Flourished.
Fla.— Florida.
Fl. E.— Flemish ells.
F. L. S.— Fellow of the Linnæan Society.
Fm.; Fms.— Fathom; Fathoms.
F.-M.— Field-Marshal.
Fo.— Folio.
F.-O.— Field-Officer.
F. o. b.— Free on board.
Fol.— Folio.
For.— Foreign.
F. P. S.— Fellow of the Philological Society.
Fr.— *Fragmentum,* fragment; Franc; France; Francis; Francs; French; From.
F. R. A. S.— Fellow of the Royal Asiatic Society; Fellow of the Royal Astronomical Society.
F. R. C. P.— Fellow of the Royal College of Physicians.
F. R. C. S. (E., I., or L.).— Fellow of the Royal College of Surgeons (Edinburgh, Ireland, or London).
Fr. E.— French ells.
Fred.— Frederick.
F. R. G. S.— Fellow of the Royal Geographical Society.
F. R. Hist. Soc.— Fellow of the Royal Historical Society.
Fri.— Friday.
Frs.— Frisian.
F. R. S.— Fellow of the Royal Society.
F. R. S. E.— Fellow of the Royal Society, Edinburgh.
F. R. S. L.— Fellow of the Royal Society, London.
F. R. S. S. A.— Fellow of the Royal Scottish Society of Arts.
F. S. A.— Fellow of the Society of Arts, or of Antiquaries.
F. S. A. E.— Fellow of the Society of Antiquaries, Edinburgh.
F. S. A. Scot.— Fellow of the Society of Antiquaries of Scotland.
F. S. S.— Fellow of the Statistical Society.
Ft.— Foot; feet; Fort.
Fth.— Fathom.
Fur.— Furlong.
F. Z. S.— Fellow of the Zoological Society.

G.— Guineas.
G: (Lib. cat.).— George.
G.. (Lib. cat.).— Grace.
Ga.— Georgia.
G. A.— General Assembly.
Galv.— Galvanism; Galveston.
G. A. R.— Grand Army of the Republic.
G. B.— Great Britain.
G. B. & I.— Great Britain and Ireland.
G. C.— Grand Chapter; Grand Conductor; Grand Cross.
G. C. B.— Grand Cross of the Bath.
G. C. H.— Grand Cross of Hanover.
G. C. K. P.— Grand Commander of the Knights of St. Patrick.
G. C. L. H.— Grand Cross of the Legion of Honor.
G. C. M. G.— Grand Cross of St. Michael and St. George.
G. C. S. I.— Grand Commander of the Star of India.
G. D.— Grand Duke; Grand Duchess.
G. E.— Grand Encampment.
Gen.— Genealogy; Genera; General; Genesis; Genus.
Gent.— Gentleman.
Geo.— George.
Geog.— Geography.
Geol.— Geology.
Geom.— Geometry.
Ger.— German; Germany.
Gl., or Gloss.— Glossary.
G. L.— Grand Lodge.
G. M.— Grand Master.
G. M. K. P.— Grand Master of the Knights of St. Patrick.
G. M. S. I.— Grand Master of the Star of India.
G. O.— General Order.
Goth.— Gothic.
Gov.— Governor.
Gov.-Gen.— Governor-General.
Govt.— Government.
G. P.— *Gloria Patri,* « Glory be to the Father.»
G. P. O.— General Post-Office.
Gr.— Greek; Gross.
G. R.— *Georgius Rex,* King George.
Gr., Grs.— Grain; Grains.
Grad.— Graduated.
Gram.— Grammar.
Grot.— Grotius.
G. S.— Grand Secretary; Grand Sentinel; Grand Scribe.
G. T.— Good Templars; Grand Tyler
Gtt.— *Gutta* or *guttæ,* drop; drops.

H.— Hour.
H: (Lib. cat.).— Henry.
H.. (Lib. cat.).— Helen.
H. A.— *Hoc anno,* this year.
Hab.— Habakkuk.
Hab. corp.— *Habeas corpus,* that you have the body.
Hab. fa. poss.— *Habere facias possessionem,* that you cause to have possession,— a legal writ.
Hab. fa. seis.— *Habere facias seisinam,* that you cause to have seisin,— a legal writ.
Hag.— Haggai.
Hants.— Hampshire.
H. B. C.— Hudson Bay Company.
H. B. M.— His or Her Britannic Majesty.
H. B. M. S.— His (or Her) Britannic Majesty's Ship.
H. C.— House of Commons; Heralds' College.
H. C. M.— His or Her Catholic Majesty.
Hdkf.— Handkerchief.
H. E.— His Excellency; *Hoc est,* that is, or this is.
Heb.— Hebrew; Hebrews.
H. E. I. C. S.— Honorable East India Company's Service.
Her.— Heraldry.
Herp.— Herpetology.
Hf.-bd.— Half-bound.
H. G.— Horse Guards.
H. H.— His or Her Highness; His Holiness (the Pope).
Hhd.— Hogshead.
H. I.— Hawaiian Islands.
Hier.— *Hierosolyma,* Jerusalem.
H. I. H.— His or Her Imperial Highness.
Hil.— Hilary.
Hind.— Hindu; Hindustan; Hindustanee.
Hipp.— Hippocrates.

Hist.— Historical; History.
H. J. S.— *Hic jacet sepultus*, here lies buried.
H. L.— House of Lords.
H. M.— His or Her Majesty.
H. M. P.— *Hoc monumentum posuit*, erected this monument.
H. M. S.— His or Her Majesty's Ship or Service.
Holl.— Holland.
Hon.— Honorable.
Hort.— Horticulture.
Hos.— Hosea.
H.-P.— High-priest; Horse-power; Half-pay.
Hr.— Hour.
H. R.— House of Representatives
H. R. E.— Holy Roman Empire.
H. R. H.— His or Her Royal Highness.
H. R. I. P.— *Hic requiescit in pace*, Here rests in peace.
H. S.— *Hic situs*, Here lies.
H. S. H.— His or Her Serene Highness.
H. T.— *Hoc titulum*, this title; *hoc titulo*, in or under this title.
Hund.— Hundred.
Hung.— Hungarian.
H. V.— *Hoc verbum*, this word; *his verbis*, in these words.
Hyd.—Hydraulics; Hydrostatics.
Hypoth.— Hypothesis; Hypothetical.

I.— Island.
I: (Lib. cat.).— Isaac.
I.. (Lib. cat.).— Isabella.
Ia.— Iowa.
Ib., or ibid.— *Ibidem*, in the same place.
Icel.— Iceland; Icelandic.
Ich., or Ichth.— Ichthyology.
Icon. Encyc.— Iconographic Encyclopedia.
I. Ch. Th. U. S.—'Ι(ησοῦς) Χ(ριστὸς) Θ(εοῦ) Υ(ἱὸς) Σ(ωτήρ) (*Iesous Christos, Theou Uios, Soter*), Jesus Christ, the Son of God, the Saviour; also written Ιχθὺς = a fish; whence the symbol of a fish for the sacred name.
Id.— *Idem*, the same; *Idus*, the Ides; Island.
Ida.— Idaho.
I. E.— *Id est*, that is.
I. G.— Inside Guardian.
I. H. S.—(Corrupted from Gr. ΙΗΣ, abbrev. of ΙΗΣΟΥΣ, Jesus). Now read *Jesus Hominum Salvator*, Jesus the Saviour of Men.
Ill.— Illinois.
Imp.— Imperative; *Imperator*, emperor; Imperfect; Imperial.
In.— Inch; inches.
Inc. or Incor.— Incorporated.
Incog.— *Incognito*, unknown.
Ind. T., or Ind. Ter.— Indian Territory.
I. H. P.— Indicated horse-power.
Ind.— Indiana; Index.
I. N. D.— *In nomine Dei*, in the name of God.
Indef.— Indefinite.
Inf.— *Infra*, beneath, or below.
In f.— *In fine*, at the end.
Inhab.— Inhabitant; Inhabited.
In lim.— *In limine*, at the outset.
In loc.— *In loco*, in the place.
In pr.— *In principio*, in the beginning.
I. N. R. I.— *Jesus Nazarenus, Rex Judæorum*, Jesus of Nazareth, King of the Jews.
Inst.—Instant; Institute; Institutes; Institution.
Int.—Interest.
Int. Dept.— Department of the Interior.
Interj.—Interjection.
In trans.— *In transitu*, in transit.
Int. Rev.— Internal Revenue.
Introd.— Introduction.
Ion.— Ionic.
I. O. O. F.— Independent Order of Odd Fellows.
I. O. S. M.— Independent Order of the Sons of Malta.
I. O. U.— I owe you.
Ipecac.— Ipecacuanha.
I. Q.— *Idem quod*, the same as.
Ire.— Ireland.
I. R. O.— Internal Revenue Office.
Is., Isl.— Island; Islands.
Isa.— Isaiah.
It.— Italy.
I. T.— Inner Temple.
Ital.— Italic; Italian.
I. W.— Isle of Wight.

J.— Justice, or Judge.
J: (Lib. cat.).— John.
J.. (Lib. cat.).— Jane.
J. A.— Judge-Advocate.
Jac.— Jacob; *Jacobus*, James.
J. A. G.— Judge Advocate-General.
Jam.— Jamaica.
Jan.— January.
Jas.— James.
Jc.— Junction.
J. C.— *Jurisconsultus*, jurisconsult.
J. C. D.— *Juris Civilis Doctor*, Doctor of Civil Law.
J. D.— Junior Deacon.
Jer.— Jeremiah.
J. G. W.— Junior Grand Warden.
JJ.— Justices.
Jno.— John.
Jona.— Jonathan.
Jos.— Joseph.
Josh.— Joshua.
J. P.—Justice of the Peace.
J. Prob.— Judge of Probate.
Jr.— Junior.
J. R.— *Jacobus Rex*, King James.
Jud.— Judicial; Judith.
J. U. D., or J. V. D.— *Juris utriusque Doctor*, Doctor of both laws (of the Canon and the Civil Law).
Judg.— Judges.
Judge-Adv.— Judge-Advocate.
Jul. Per.— Julian Period.
Jun.— Junior.
Junc.— Junction.
Jus. P.— Justice of the Peace.
Just.— Justinian.
J. W.— Junior Warden.

K.— Karat; Karats; King.
K: (Lib. cat.).— Karl.
K.. (Lib. cat.).— Katharine.
K. A.— Knight of St. Andrew, in Russia.
Kal.— *Kalendæ*, the Kalends.
Kan.— Kansas.
K. A. N.— Knight of Alexander Nevskoi, in Russia.
K. B.— King's Bench; Knight of the Bath.
K. B. A.— Knight of St. Bento d'Avis, in Portugal.
K. B. E.— Knight of the Black Eagle, in Russia.
K. C.— King's Counsel; Knight of the Crescent, in Turkey.

K. C. B.—Knight Commander of the Bath.
K. C. H.—Knight Commander of Hanover.
K. C. S.—Knight of Charles III. of Spain.
K. E.—Knight of the Elephant, in Denmark.
K. F.—Knight of Ferdinand, in Spain.
K. F. M.—Knight of St. Ferdinand and Merit, in Sicily.
Kg., Kgs.—Keg; Kegs.
K. G.—Knight of the Garter.
K. G. C.—Knight of the Golden Circle; Knight of the Grand Cross.
K. G. C. B.—Knight of the Grand Cross of the Bath.
K. G. F.—Knight of the Golden Fleece, in Spain.
K. G. H.—Knight of the Guelphs of Hanover.
K. G. V.—Knight of Gustavus Vasa, in Sweden.
K. H.—Knight of Hanover.
Ki.—Kings.
Kilo., Kilog.—Kilogram.
Kilo., Kilom.—Kilometer.
Kingd.—Kingdom.
K. J.—Knight of St. Joachim.
K. L.—Knights of Labor.
K. L., or K. L. A.—Knight of Leopold of Austria.
K. L. H.—Knight of the Legion of Honor.
K. M.—Knight of Malta.
K. Mess.—King's Messenger.
K. M. H.—Knight of Merit of Holstein.
K. M. J.—Knight of Maximilian Joseph, in Bavaria.
K. M. T.—Knight of Maria Theresa, in Austria.
Knick.—Knickerbocker.
K. N. S.—Knight of the North Star, in Sweden.
Knt. or Kt.—Knight.
K. P.—Knight of St. Patrick; Knight of Pythias.
K. R. C.—Knight of the Red Cross.
K. R. E.—Knight of the Red Eagle, in Prussia.
K. S.—Knight of the Sword, in Sweden.
K. S. A.—Knight of St. Anne, in Russia.
K. S. E.—Knight of St. Esprit, in France.
K. S. F.—Knight of St. Fernando, in Spain.
K. S. F. M.—Knight of St. Ferdinand and Merit, in Naples.
K. S. G.—Knight of St. George, in Russia.
K. S. H.—Knight of St. Hubert, in Bavaria.
K. S. J.—Knight of St. Januarius, in Naples.
K. S. L.—Knight of the Sun and Lion, in Persia.
K. S. M. & S. G.—Knight of St. Michael and St. George, in the Ionian Islands.
K. S. P.—Knight of St. Stanislaus of Poland.
K. S. S.—Knight of the Southern Star, in Brazil; Knight of the Sword of Sweden.
K. S. W.—Knight of St. Wladimir, in Russia.
Kt.—Knight.
K. T.—Knight of the Thistle; Knight Templar.
K. t. l. (Gr. K.τ.λ).—Και τα λείπομενα (*kai ta leipomena*), or λοιπα (*loipa*), and so forth; and the rest; same as « etc.»
K. T. S.—Knight of the Tower and Sword, in Portugal.
K. W.—Knight of William, in the Netherlands.
K. W. E.—Knight of the White Eagle, in Poland.
Ky.—Kentucky.

L.—Lake; *Liber*, book; *Libra, libræ*, pound, pounds
L: (Lib. cat.).—Louis.
L.. (Lib. cat.).—Louise.
La.—Louisiana.
L. A. C.—Licentiate of the Apothecaries' Company.
Lam.—Lamentations.
Lang.—Language.
Lapp.—Lappish.
Lat.—Latitude; Latin.
L. A. W.—League of American Wheelmen.
Lb., or lbs.—*Libra* or *libræ*, pound or pounds in weight.
L. C.—*Loco citato*, in the place cited; Lord Chamberlain; Lord Chancellor; Lower Canada; Lower case.
L. C. B.—Lord Chief Baron.
L. C. J.—Lord Chief Justice.
L. C. M.—Least common multiple.
Ld.—Lord; Limited.
Ldp.—Lordship.
Leg.—Legal; Legate.
Legis.—Legislature.
Leip.—Leipsic.
Lett.—Lettish.
Lev.—Leviticus.
Lex.—Lexicon.
L. G.—Life Guards.
L. H. A.—Lord High Admiral.
L. H. C.—Lord High Chancellor.
L. H. D.—*Litterarum Humaniorum Doctor*, Doctor of the More Humane Letters.
L. H. T.—Lord High Treasurer.
L. I.—Long Island.
Lib.—*Liber*, book.
Lieut.—Lieutenant.
Lieut.-Col.—Lieutenant-Colonel.
Lieut.-Gen.—Lieutenant-General.
Lieut.-Gov.—Lieutenant-Governor
Lim.—Limited.
Lin.—Lineal.
Linn.—Linnæus; Linnæan.
Liq.—Liquid; Liquidation; Liquor.
Lit.—Literally; Literature.
Lith.—Lithuanian.
L. L.—*Loco laudato*, in the place praised (quoted); Lord Lieutenant.
L. Lat.—Low Latin; Law Latin.
LL. B.—*Legum Baccalaureus*, Bachelor of Laws.
LL. D.—*Legum Doctor*, Doctor of Laws.
LL. M.—*Legum Magister*, Master of Laws.
L. M.—Long metre.
L. M. D.—Long metre double.
L. M. S.—London Missionary Society.
Loc. cit.—*Loco citato*, in the place cited.
Lon.—Longitude.
Lond.—London.
L. P.—Large Paper; Lord Provost.
L. P. M.—Long particular metre.
L. P. S.—Lord Privy Seal.
L. R. C. P.—Licentiate of the Royal College of Physicians.
L. R. C. S.—Licentiate of the Royal College of Surgeons.
L. S.—*Locus sigilli*, place of the seal.
L. S. D.—Pounds, shillings, and pence.
Lt.—Lieutenant.
Lt. Inf.—Light Infantry.
L. U. E.—Left upper entrance.
LXX.—The Septuagint (Version of the Old Testament).

M.—Married; *Meridies*, noon; Mile; *Mille*, a thousand; Minute, minutes; *Monsieur*, mister.
M: (Lib. cat.).—Matthew.
M.. (Lib. cat.).—Mary.
M. A.—Master of Arts; Military Academy.

M. Am. Soc. C. E.— Member American Society Civil Engineers.
Macc.— Maccabees.
Maced.— Macedonian.
Mag.— Magazine.
Maj.— Major.
Maj.-Gen.— Major-General.
Mal.— Malachi.
Man.— Manassas.
Mar.— March.
March.— Marchioness.
Marg.— Margin; Marginal.
Marq.— Marquis.
Masc.— Masculine.
Mass.— Massachusetts.
Math.— Mathematics; Mathematician.
Matt.— Matthew.
Max.— Maxim.
M. B.— *Medicinæ Baccalaureus,* Bachelor of Medicine; *Musicæ Baccalaureus,* Bachelor of Music.
M. B. F. et H.— *Magna Britannia, Francia, et Hibernia,* Great Britain, France, and Ireland.
M. C.— Member of Congress; Master of Ceremonies; Master Commandant.
Mch.— March.
M. C. S.— Madras Civil Service.
Md.— Maryland.
M. D.— *Medicinæ Doctor,* Doctor of Medicine.
Mdlle.— Mademoiselle.
Mdse.— Merchandise.
Me.— Maine.
M. E.— Methodist Episcopal; Military or Mechanical Engineer.
Mech.— Mechanic; Mechanical.
Med.— Medicine.
M. E. G. H. P.— Most Excellent Grand High Priest.
Mem.— *Memento,* remember; Memorandum.
Merc.— Mercury.
M. E. S.— Methodist Episcopal, South.
Mess. & Docs.— Messages and Documents.
Messrs.—*Messieurs,* Gentlemen.
Met.— Metaphysics.
Metal.— Metallurgy.
Meteor.— Meteorology.
Meth.— Methodist.
Mex.— Mexico, or Mexican.
M. F. A.— Minister of Foreign Affairs.
Mfd.— Manufactured.
Mfg.— Manufacturing.
M. F. H.— Master of Foxhounds.
Mfrs.— Manufacturers.
Mfs.— Manufactures.
M. Goth.— Mœso-Gothic.
Mic.— Micah.
M. I. C. E.— Member of the Institution of Civil Engineers.
Mich.— Michael; Michaelmas; Michigan.
Mil.— Military.
Min.— Mineralogy; Mining; Minute, minutes.
Minn.— Minnesota.
Min. Plen.— Minister Plenipotentiary.
Mir. for Mag.— Mirror for Magistrates.
Miss.— Mississippi.
M. L. A.— Mercantile Library Association.
MM.— *Messieurs,* Gentlemen; (Their) Majesties.
Mme.— *Madame,* Madam.
M. M. S.— Moravian Missionary Society.
M. M. S. S.— *Massachusettensis Medicinæ Societatis Socius,* Fellow of the Massachusetts Medical Society.
M. N. A. S.— Member of the National Academy of Sciences.
Mo.— Missouri; Month.
Mod.— Modern.
Mon.— Montana; Monday.
Mons.— *Monsieur,* Sir.
Mont.— Montana.
Morn.— Morning.
Mos.— Months.
M. P.— Member of Parliament; Member of Police; Methodist Protestant.
M. P. P.— Member of Provincial Parliament.
M. P. S.— Member of the Philological Society; Member of the Pharmaceutical Society.
Mr.—Mister.
M. R.— Master of the Rolls.
M. R. A. S.— Member of the Royal Asiatic Society; Member of the Royal Academy of Science.
M. R. C. C.— Member of the Royal College of Chemistry.
M. R. C. P.— Member of the Royal College of Preceptors.
M. R. C. S.— Member of the Royal College of Surgeons.
M. R. C. V. S.— Member of the Royal College of Veterinary Surgeons.
M. R. G. S.— Member of the Royal Geographical Society.
M. R. I.— Member of the Royal Institution.
M. R. I. A.— Member of the Royal Irish Academy.
Mrs.— Mistress.
M. R. S. L.— Member of the Royal Society of Literature.
MS.— *Manuscriptum,* manuscript.
M. S.— Master of Science; *Memoriæ sacrum,* sacred to the memory.
M. S. A.— Master of Science in Agriculture.
M. S. L.— Mean sea level.
MSS.— *Manuscripta,* manuscripts.
Mt.— Mount, or mountain.
M. T. C.— Marcus Tullius Cicero.
Mth; Mths.— Month; Months.
Mus. B.— *Musicæ Baccalaureus,* Bachelor of Music.
Mus. D.— *Musicæ Doctor,* Doctor of Music.
M. W.— Most Worthy; Most Worshipful.
M. W. G. C. P.— Most Worthy Grand Chief Patriarch.
M. W. G. M.— Most Worthy Grand Master; Most Worshipful Grand Master.
M. W. P.— Most Worthy Patriarch.
Myth.— Mythology.

N.— Neuter; North; Note; Noun; Number.
N: (Lib. cat.).— Nicholas.
N.. (Lib. cat.).— Nancy.
Na.— Nail.
N. A.— National Academician; North America; North American.
Nah.— Nahum.
Nap.— Napoleon; Napoleonic.
N. A. S.— National Academy of Sciences.
Nat.— Natural.
Nath.— Nathanael, or Nathaniel.
Nat. Ord.— Natural Order.
Naut.— Nautical.
Naut. Alm.— Nautical Almanac.
N. B.—New Brunswick; North Britain (i.e. Scotland); North British (i.e. Scotch); *Nota bene,* mark well; take notice.
N. C.— North Carolina.

N. D.— No date; Not dated; North Dakota.
N. E.—New England; Northeast.
Neb.— Nebraska.
Neh.— Nehemiah.
N. e. i.— *Non est inventus,* he is not found.
Nem. con., or nem. diss.— *Nemine contradicente,* or *nemine dissentiente,* no one opposing or dissenting; unanimously.
Neth.— Netherlands.
Neut.— Neuter (gender).
Nev.— Nevada.
N. F.— Newfoundland.
N. G.— New Granada; Noble Grand; (slang) No good.
N. H.— New Hampshire.
N. J.— New Jersey.
N. l.— *Non liquet,* it does not appear.
N. lat.— North latitude.
N. M.— New measurement; New Mexico.
N. N. E.— North-northeast.
N. N. W.— North-northwest.
No.— *Numero,* number.
N. O.— New Orleans.
Nol. Pros.— *Nolle prosequi,* unwilling to proceed.
Nom.— Nominative.
Non-com.— Non-commissioned (officer).
Non con.— Not content; dissenting (House of Lords).
Non cul.— *Non culpabilis,* not guilty.
Non obst.— *Non obstante,* notwithstanding.
Non pros.— *Non prosequitur,* he does not prosecute.
Non seq.— *Non sequitur,* it does not follow
N. o. p.— Not otherwise provided for.
Nos.— Numbers.
Notts.— Nottinghamshire.
Nov.— November.
N. P.—*Nisi Prius;* Notary Public.
N. P. D.— North Polar Distance.
N. S.— New Series; New Style (after 1752); Not specified; Nova Scotia.
N. S. J. C.—*Noster Salvator Jesus Christus,* Our Saviour Jesus Christ.
N. S. W.— New South Wales.
N. T.— New Testament.
N. u.— Name or names unknown.
Num.— Numbers (Book of); Numeral.
N. V.— New Version.
N. V. M.— Nativity of the Virgin Mary.
N. W.— Northwest.
N. W. T.— Northwest Territory.
N. Y.—New York.
N. Z.— New Zealand.

O.— Ohio.
O: (Lib. cat.).— Otto.
O.. (Lib. cat.).— Olivia.
Ob.— *Obiit,* he or she died.
Obad.— Obadiah.
Obs.— Obsolete; Observatory; Observation.
Obt., or Obdt.— Obedient.
Oct.— October.
Oct., or 8vo.— Octavo.
O. F.— Odd Fellow, or Odd Fellows.
O. G.— Outside Guardian.
O. H. M. S.— On His or Her Majesty's Service.
O. K. (Jocular)— All right or correct.
Okl.— Oklahoma.
Olym.— Olympiad.
O. M.— Old Measurement.
Ont.— Ontario.
Opt.— Optics.
Or., Ore., Oreg.— Oregon.
Orig.— Originally.
Ornith.— Ornithology.
O. S.— Old Series; Old Style; Outside Sentinel.
O. T.— Old Testament.
O. U. A.— Order of United Americans.
Oxf.— Oxford.
Oxon.— *Oxonia,* Oxford; *Oxoniæ, Oxoniensis,* of Oxford.
Oz.— *Onza,* ounce.

P.— Page; Part; Participle; *Pondere,* by weight.
P: (Lib. cat.).— Peter.
P.. (Lib. cat.).— Pauline.
Pa., or Penn.— Pennsylvania.
Pal.— Palæontology.
Par.— Paragraph.
Parl.— Parliament.
Par. Pas.— Parallel passage.
Pathol.— Pathology.
Pat. Of.— Patent Office.
Paym.-Gen.— Paymaster-General.
Payt.— Payment.
P. B.— *Philosophiæ Baccalaureus,* Bachelor of Philosophy; Primitive Baptist.
P. C.— *Patres Conscripti,* Conscript Fathers, Senators; Postal card; Privy Council; Privy Councilor.
P. C. P.— Past Chief Patriarch.
P. C. S.— Principal Clerk of Sessions.
Pd.— Paid.
P. D.— *Philosophiæ Doctor,* Doctor of Philosophy.
P. E.— Protestant Episcopal.
P. E. I.— Prince Edward Island.
Penn.— Pennsylvania.
Pent.— Pentecost.
Per.— Persia; Persian.
Per an.— *Per annum,* by the year.
Per cent.— *Per centum,* by the hundred.
Peri.— Perigee.
Per proc.— *Per procurationem,* by procuration, or by power of attorney.
Peruv.— Peruvian.
Pet.— Peter; Petrine.
P. G.— Past Grand.
Phar.— Pharmacy.
Ph. B.— *Philosophiæ Baccalaureus,* Bachelor of Philosophy.
Ph. D.— *Philosophiæ Doctor,* Doctor of Philosophy.
Phil.— Philadelphia; Philemon; Philip; Philippians; Philosophical; Philosophy.
Phila.— Philadelphia.
Philem.— Philemon.
Philom.— *Philomathes,* a lover of learning.
Philomath.— *Philomathematicus,* a lover of mathematics.
Phren.— Phrenology.
P. I.— Philippine Islands.
Pinx., or pxt.— *Pinxit,* he (she) painted it.
Pk.— Peck.
Pkt.— Packet.
Pl., or Plur.— Plural.
P. L.— Poet Laureate.
Plff.— Plaintiff.
Plupf.— Pluperfect.
P. M.— Passed Midshipman; *Post meridiem,* afternoon, evening; Postmaster.
P. M. G.— Postmaster-General.
Po.— Pole.
P. O.— Post-Office; Province of Ontario.
P. of H.— Patrons of Husbandry.

P.-O. O.— Post-Office order.
Pop.— Population.
Port.— Portugal, or Portuguese.
Pp.— Pages.
PP.— *Patres*, Fathers.
P. P.— Parish priest; *Per procurationem*, by procuration, or by power of attorney.
P. P. C.— *Pour prendre congé*, to take leave.
Pph.— Pamphlet.
P. Q.— Previous Question; Province of Quebec.
Pr.— *Per*, by, or by the.
P. R.— *Populus Romanus*, the Roman people; Porto Rico; Prize Ring.
P. R. A.— President of the Royal Academy.
P. R. C.— *Post Romanum conditum*, from the building of Rome.
Preb.— Prebend.
Pref.— Preface; Preferred.
Prep.— Preparatory; Preposition.
Pres.— President.
Presb.— Presbyterian.
Prin.— Principally.
Priv.— Privative.
Pro.— Procedure.
Prob.— Probably; Problem.
Proc.— Proceedings; Procedure.
Prof.— Professor.
Pron.— Pronoun; Pronounced; Pronunciation.
Prop.— Proposition.
Prot.— Protestant.
Pro tem.— *Pro tempore*, for the time being.
Prov.— Proverbs; Province; Provost.
Prox.— *Proximo*, next (month).
Prs.— Pairs.
P. R. S.— President of the Royal Society.
Prus.— Prussia; Prussian.
Ps.— Psalm, or Psalms.
P. S.— Paddle steamer; *Post scriptum*, postscript; Privy Seal.
Psych.— Psychic; Psychical; Psychology.
Pt.— Part; Pint; Payment; Point; Port.
P. T. O.— Please turn over.
Pub.— Publisher; Publication; Published; Public.
P. v.— Post-village.
P. W. P.— Past Worthy Patriarch.
Pwt.— Pennyweight; pennyweights.
Pxt.— *Pinxit*, he (or she) painted it.

Q.—*Quadrigans*, farthing; *Quasi*, as it were, almost; Queen; Query, or question.
Q. B.— Queen's Bench.
Q. C.— Queen's College; Queen's Counsel.
Q. d.— *Quasi dicat*, as if he should say; *quasi dictum*, as if said; *quasi dixisset*, as if he had said.
Q. e.— *Quod est*, which is.
Q. e. d.— *Quod erat demonstrandum*, which was to be proved.
Q. e. f.— *Quod erat faciendum*, which was to be done.
Q. e. i.— *Quod erat inveniendum*, which was to be found out.
Q. l.— *Quantum libet*, as much as you please.
Qm.— *Quomodo*, how; by what means.
Q. M.— Quartermaster.
Q. Mess.— Queen's Messenger.
Q. M. G.— Quartermaster-General.
Q. p., or q. pl.— *Quantum placet*, as much as you please.
Qr.— Quarter.
Q. S.— *Quantum sufficit*, as much as may suffice; Quarter Sessions.
Qt.— Quart.
Qu., or qy.— *Quære*, inquire; query.
Quad.— Quadrant; Quadrate.
Quar.— Quarterly.
Que.— Quebec.
Ques.— Question.
Q. v.— *Quod vide*, which see; *Quantum vis*, as much as you will.

R.— Railroad; Railway; *Recipe*, take; *Regina*, Queen; River; Rod; Rood.
R: (Lib. cat.).— Richard.
R.. (Lib. cat.).— Rebecca.
R. A.— Royal Academician; Royal Academy; Royal Arch; Royal Artillery.
RC.— *Rescriptum*, a counterpart.
R. C.— Roman Catholic.
R. C. S.— Royal College of Surgeons.
R. C. P.— Royal College of Physicians.
R. D.— Rural Dean.
R. E.— Reformed Episcopal; Royal Engineers.
Rec.— Recipe; Record; Recorder; Recording.
Recd.— Received.
Rect.— Rector; Receipt.
Ref.— Reformed; Reformation; Reference.
Reg.— Regiment; Register; Registrar; Regular.
Reg. Prof.— *Regius Professor*, Royal Professor.
Rel.— Religion.
Rep.— Report; Reporter; Representative; Republic; Republican.
Retd.— Returned.
Rev.— Reverend; Revelation (Book of); Review; Revenue; Revise.
Rhet.— Rhetoric.
R. H. S.— Royal Humane Society; Royal Historical Society.
R. I.— Rhode Island.
R. I. P.— *Requiescat in pace*, Let him (her) rest in peace.
R. M.— Royal Marines; Royal Mail.
R. M. S.— Railway Mail Service; Royal Mail Service; Royal Mail Steamer.
R. N.— Royal Navy.
R. N. R.— Royal Naval Reserve.
Ro.— *Recto*, right-hand page; rood.
Robt.— Robert.
Rom.— Roman; Romans.
R. P.— Reformed Presbyterian; *Regius Professor*, Royal Professor.
R. R.— Railroad.
Rs.— Rupees.
R. S.— Recording Secretary.
R. S. A.— Royal Society of Antiquaries; Royal Scottish Academy.
R. S. V. P.— *Répondez, s'il vous plaît*, answer, if you please.
Rt. Hon.— Right Honorable.
Rt. Rev.— Right Reverend.
R. T. S.— Religious Tract Society.
Rt. Wpful.— Right Worshipful.
R. U. E.— Right upper entrance.
Russ.— Russia; Russian.
R. V.— Revised Version.
R. W. D. G. M.— Right Worshipful Deputy Grand Master.
R. W. G. R.— Right Worthy Grand Representative.
R. W. G. S.— Right Worthy Grand Secretary.
R. W. G. T.— Right Worthy Grand Treasurer; Right Worshipful Grand Templar.
R. W. G. W.— Right Worthy Grand Warden.
R. W. J. G. W.— Right Worshipful Junior Grand Warden.

R. W. S. G. W.— Right Worshipful Senior Grand Warden.
Rx.— Rupees.
Ry.— Railway.

S.— Saint; Scribe; Second; Series; *Solidus,* a shilling; South; Sun; Sunday.
S: (Lib. cat.).— Samuel.
S.. (Lib. cat.).— Sarah.
S. A.— *Secundum artem,* according to art; South America; South Australia.
Sam.— Samuel.
Sansc., or Sansk.— Sanscrit, or Sanskrit.
Sard.— Sardinia.
S. A. S.— *Societatis Antiquariorum Socius,* Fellow of the Society of Antiquaries.
Sat.— Saturday.
Sax.— Saxon; Saxony.
S. C.— *Senatus Consultum,* a decree of the Senate; Small capitals; South Carolina; Staff Corps; Supreme Court.
Sc.— Scene; *Scilicet,* namely, to wit; Scruple; *Sculpsit,* he (or she) engraved it.
Scan. Mag.— *Scandalum magnatum,* scandal of the great.
Scapa (S. C. A. P. A.).— Society for Checking Abuses in Public Advertising.
Sc. B.— *Scientiæ Baccalaureus,* Bachelor of Science.
Schol.— *Scholium,* a note.
Schr.— Schooner.
Sclav.— Sclavonic.
Scot.— Scottish; Scotland.
Scr.— Scruple.
Scrip.— Scripture.
Sculp.— *Sculpsit,* he (or she) engraved it.
S. D.— *Salutem dicit,* sends health; Senior Deacon; South Dakota.
S. D. U. K.— Society for the Diffusion of Useful Knowledge.
S. E.— Southeast.
Sec.— Secretary; Second; Section.
Sec. Leg.— Secretary of Legation; *Secundum legem,* according to law.
Sec. Reg.— *Secundum regulam,* according to rule.
Sect.— Section.
Sem.— *Semble,* it seems; Seminary.
Sen.— Senate; Senator; Senior.
Sept.— September; Septuagint.
Seq.— *Sequentia,* following; *Sequitur,* it follows.
Ser.— Series.
Serg.— Sergeant.
Serg.-Maj.— Sergeant-Major.
Servt.— Servant.
Sess.— Session.
S.-G.— Solicitor-General.
Shak.— Shakespeare.
S. H. S.— *Societatis Historiæ Socius,* Fellow of the Historical Society.
S. I. M.— Society for Increase of the Ministry.
Sing.— Singular.
S. J.— Society of Jesus.
S. J. C.— Supreme Judicial Court.
S. M.— State Militia; Short Meter; Sergeant-Major; Sons of Malta.
S. M. Lond. Soc.— *Societatis Medicæ Londonensis Socius,* Member of the London Medical Society.
Soc. Isl.— Society Islands.
S. of Sol.— Song of Solomon.
Sol.— Solomon; Solution.
Sol.-Gen.— Solicitor-General.
Sp.— Spain; Spanish.
S. P.— *Sine prole,* without issue.
S. P. A. S.— *Societatis Philosophicæ Americanæ Socius,* Member of the American Philosophical Society.
S. P. C. A.— Society for the Prevention of Cruelty to Animals.
S. P. C. C.— Society for the Prevention of Cruelty to Children.
S. P. C. K.— Society for the Promotion of Christian Knowledge.
S. P. G.— Society for the Propagation of the Gospel.
Sp. gr.— Specific gravity.
S. P. M.— Short particular metre.
S. P. Q. R.— *Senatus Populusque Romanus,* the Senate and people of Rome.
S. P. R. L.— Society for the Promotion of Religion and Learning.
Sq.— *Sequens,* following; usually *et seq.,* and following (pages); Square.
Sqq.— *Sequentibus,* the following (pages or places).
Sr.— Senior.
S. R. I.— *Sacrum Romanum Imperium,* Holy Roman Empire.
S. R. S.— *Societatis Regiæ Socius,* Fellow of the Royal Society.
SS.— Saints; *Scilicet,* to wit; *Semis,* half; Sessions.
S. S.— Screw steamer; Steamship; Sunday-school.
S. S. E.— South-southeast.
S. S. W.— South-southwest.
St.— Saint; Statute; Stone; Strait; Street.
Sta.— Station.
Stat.— Statute.
S. T. B.— *Sacræ Theologiæ Baccalaureus,* Bachelor of Sacred Theology.
S. T. D.— *Sacræ Theologiæ Doctor,* Doctor of Sacred Theology.
Ster., or Stg.— Sterling.
S. T. P.— *Sacræ Theologiæ Professor,* Professor of Sacred Theology.
Str.— Steamer.
Subj.— Subjunctive.
Subst.— Substantive.
Su.-Goth.— Suio-Gothic.
Sun., or Sund.— Sunday.
Sup.— Superfine; Supplement; *Supra,* above, Supreme.
Supt.— Superintendent.
Surg.— Surgeon; Surgery.
Surg.-Gen.— Surgeon-General.
Surv.— Surveyor.
S. V.— *Sub voce,* under the word or title.
Sw.— Swiss.
S. W.— Southwest.
Swe.— Sweden; Swedish; Swedenborg; Swedenborgian.
Switz.— Switzerland.
Syn.— Synonym; Synonymous.
Syr.— Syriac.

T.—Term; Territory; *Tome,* volume.
T: (Lib. cat.).—Thomas.
T.. (Lib. cat.).— Theresa.
Tab.— Table; Tabular.
Tan.— Tangent.
T. E.— Topographical Engineers.
Tenn.— Tennessee.
Ter.— Territory.
Tex.— Texas.

Text. Rec.— *Textus Receptus,* Received Text.
Tf.—Till forbidden.
Tfn.—Till further notice.
Th.—Thursday.
Theo.—Theodore.
Theol.—Theology; Theological.
Theoph.—Theophilus.
Theor.—Theorem.
Thess.—Thessalonians.
Thos.—Thomas.
Thurs.—Thursday.
Tim.—Timothy.
Tit.—Title; Titus.
T. O.—Turn over.
Tob.—Tobit.
Tom.—*Tome,* volume.
Topog.—Topography; Topographical.
Tp.—Township.
Tr.—Transpose; Translator; Translation; Trustee.
Trans.—Translator; Translation; Transactions; Transpose.
Treas.—Treasurer.
Trin.—Trinity.
Tr. S.—Triple screw.
T. S.—Twin screw.
Tu., Tue., or Tues.—Tuesday.
Tur.—Turkey.
Typ.—Typical; Typographer; Typographical.

U.—Union.
U: (Lib. cat.).—Uriah.
U.. (Lib. cat.).—Ursula.
U. B.—United Brethren.
U. C.—Upper Canada; *Urbe condita,* year of the founding of Rome.
U. J. C.—*Utriusque Juris Doctor,* Doctor of both Laws (Canon and Civil).
U. K.—United Kingdom.
U. K. A.—Ulster King-at-Arms; United Kingdom Alliance.
Ult.—*Ultimo,* last; of the last month.
Unit.—Unitarian.
Univ.—Universal; Universalist; University.
U. P.—United Presbyterian.
U. S.—United States; *Ut supra,* or *uti supra,* as above.
U. S. A.—United States of America; United States Army.
U. S. M.—United States Mail; United States Marines.
U. S. M. A.—United States Military Academy.
U. S. M. C.—United States Marine Corps.
U. S. M. H. S.—United States Marine Hospital Service.
U. S. N.—United States Navy.
U. S. N. A.—United States Naval Academy.
U. S. S.—United States Senate; United States Ship.
U. s. w.—*Und so weiter,* and so further; same as «etc.»
Ut.—Utah.

V.—*Versus,* against; *Versiculo,* in such a verse; *Vide,* see; Village; Violin.
V: (Lib. cat.).—Victor.
V.. (Lib. cat.).—Victoria.
Va.—Virginia.
Val.—Valorem; Value.
Vat.—Vatican.
V. C.—Victoria Cross; Vice-Chairman; Vice-Chancellor.
V. D. L.—Van Diemen's Land.
V. D. M.—*Verbi Dei Minister,* Minister of God's word.
Ven.—Venerable.
Ver.—Verse.
V. G.—Vicar-General.
V. g.—*Verbi gratia,* as for example.
Vid.—*Vide,* see.
Visc.—Viscount.
Viz., or vl.—*Videlicet,* to wit; namely; that is to say.
Vo.—*Verso,* left-hand page.
Vol.—Volume; Volunteer.
Vols.—Volunteers.
V. P.—Vice-President.
V. R.—*Victoria Regina,* Queen Victoria.
Vs.—*Versus,* against; *Versiculo,* in such a verse.
V. S.—Veterinary Surgeon.
Vt.—Vermont.
Vul.—Vulgate.

W.—Wednesday; West.
W: (Lib. cat.).—William.
W.. (Lib. cat.).—Wilhelmina.
Wash.—Washington.
W. B. M.—Woman's Board of Missions.
W. C. A.—Woman's Christian Association.
W. C. T. U.—Women's Christian Temperance Union.
Wed.—Wednesday.
W. F.—Wrong font.
W. F. M. S.—Woman's Foreign Missionary Society.
W. H. M. A.—Woman's Home Missionary Association.
W. I.—West Indies.
Wis.—Wisconsin.
Wisd.—Wisdom (Book of).
Wk.—Week.
Wm.—William.
W. M.—Worshipful Master.
W. M. S.—Wesleyan Missionary Society.
W. N. C. T. U.—Woman's National Christian Temperance Union.
W. N. W.—West-northwest.
W. S.—Writer to the Signet.
W. S. W.—West-southwest.
Wt.—Weight.
W. Va.—West Virginia.
Wyo.—Wyoming.

X., or Xt.—Christ. (X in this and the following abbreviations is the Greek *chi.*)
X: (Lib. cat.).—Xavier.
Xmas., or Xm.—Christmas.
Xn., or Xtian.—Christian.
Xnty., or Xty.—Christianity.
Xper., or Xr.—Christopher.

Yd.—Yard.
Y. M. C. A.—Young Men's Christian Association.
Y. M. C. U.—Young Men's Christian Union.
Y. P. S. C. E.—Young People's Society of Christian Endeavor.
Yr.—Year; Your.
Yrs.—Years; Yours.
Y. W. C. A.—Young Women's Christian Association.

Zach.—Zachary.
Zech.—Zechariah.
Zeph.—Zephaniah.
Zool.—Zoology.

Abbreviators, a body of 72 writers in the Papal Chancery who have charge of sketching and putting in shape papal bulls, briefs, and consistorial decrees, and signing them in the name of the Cardinal Vice-Chancellor. This body receives its name from the fact of their taking short-hand notes of the decisions to be later expanded. They have existed at least since 1400.

Abd-er-Rahman I., äbd-er-rä'man, founder of the Moorish emirate (later caliphate) of Cordova (q.v.): b. Damascus, 731; d. 788. He was a grandson of the Ommiad caliph Hishám, and having fled to Africa escaped the frightful massacre of his family (see OMMIADS and ABBASSIDES) by Abu 'l-Abbas; a hunted fugitive in the desert, but faithfully protected by the tribesmen, who respected his blood and pitied his misfortunes. Meanwhile Spain was seething with anarchy; each new caliph sent a new emir there; the governor of Africa claimed the right to interfere on the ground that the African governors had captured it; the native chiefs were unwilling to submit to a constant succession of interlopers with no interest but their own, and at last the situation became so intolerable that the Spanish Arabs determined to choose a ruler with his residence in Spain. They selected the wandering heir of the overthrown house, and seeking him out in Africa offered him the place. He landed in Spain 25 Sept. 755, and fixed his royal seat at Cordova. His reign was one of incessant warfare. Hosein ben-Yahva, the Abbasside emir, driven from Spain, fled to Charlemagne and implored his assistance; it was granted and Hosein was re-enthroned at Saragossa, but while the Frankish army was returning through the Pyrenees, the Basque mountaineers fell upon the rear-guard and annihilated it in the pass of Roncesvalles, with its commander Roland. Saragossa was taken after two years' siege, Hosein put to death as a rebel, and Spain to the Pyrenees subdued. A formidable rising in 786 was crushed, and Abd-er-Rahman had two years of life to devote to the arts of peace and the building of his famous mosque at Cordova (now used as a cathedral), with its rows of cupolas supported by 850 pillars of jasper.

Abd-er-Rahman III., the greatest of the caliphs of Cordova, and the first under whom the emirate assumed the title of caliphate: b. 891, acceded 912; d. 961. Measured by what he found and what he left, he must be counted among the ablest rulers of history. The former was a throne to which most of the provincial governors had thrown off allegiance, and the rest rendered such obedience as suited them; a country in a state of permanent anarchy and civil war, perishing of racial, religious, and factional quarrels between Arabs and Moors; the Fatimite dynasty establishing a great empire in Africa, and looking for a speedy succession to the heritage of Spain; on the north, the new Christian states rapidly growing,—Alfonso III. had recently moved his capital across the mountains to Leon, and Sancho had founded the kingdom of Navarre,— so that what escaped the Africans would probably fall into the hands of the Christians. Abd-er-Rahman first put down the worst internal revolt, that of the family of the old brigand Omar ben Hafsun, whose stronghold in the mountains of Andalusia had become a centre for all the renegades, Christians, and rebels of the south. He tied the hands of the Fatimites by subsidizing the native princes who held out against them. The northern danger was the worst. Ordono II. in 914 raided the territory of Merida; and though Merida had thrown off allegiance to Cordova, Abd-er-Rahman wished the more to show them that he was their protector. Collecting and equipping a splendid army, in 918 he gained a great victory over the combined forces of Leon and Navarre, following it up with several campaigns in which he penetrated to Pamplona, the capital of Navarre. These victories were not final: his fortunes were checkered on the Christian side, and he suffered some defeats. But his suzerainty over Navarre was recognized, and in 960 a deposed king was reseated on the throne of Leon by Abd-er-Rahman's troops. Internally his success and glory were unqualified. At his death he left a consolidated kingdom, a full treasury in place of an empty one, internal order kept by a vigilant police, flourishing agriculture based on scientific irrigation, prosperous industries, commerce whose customs dues furnished the majority of the revenue, an income of which one-third paid the current expenses and another third was used for building, and the rest kept for a reserve, the best army in Europe, a superb navy which made him lord of the gates of the Mediterranean, and equality in diplomatic rank with the proudest sovereigns of the world.

Abd-er-Rahman, Saracen chieftain who led an army of nearly 90,000 into Gaul, and was defeated and slain near Poitiers (usually known as the battle of Tours) by Charles Martel (q.v.).

Abd-er-Rahman. See ABD-UR-RAHMAN.

Abdication, in strictness, the renunciation of any office by the holder before the expiration of its term; in actual use, applied only to sovereign rulers, *de jure* or *de facto,* who resign the crown in their lifetimes. The motives for this are as various as human fate, character, policy, or necessity, or the events of history. It may be compulsory — in which case it is really not abdication but deposition — or voluntary. Compulsion may come from foreign conquest; from foreign commands when the king is a puppet, as with the later Polish kings, or Napoleon's shifting his brothers from throne to throne; from the commands of *de facto* controllers of the state within, as with the puppet Roman emperors under the barbarian commanders-in-chief of the army; or from popular or factional insurrections. If voluntary, it may be from desire to let a constitutional machine have a fair chance to work alone, as with Sulla and Diocletian; from satiety with royal power and weariness of royal burdens, as with Murad II. of Turkey; from physical ailments and discouragement, as with the Emperor Charles V.; from penitence and desire to live a religious life, as with more than one mediæval prince who furnished real models for Shakespeare's usurper in ‹As You Like It›; from weariness of the restraints of royal etiquette, as with Christina of Sweden,— perhaps also sincere conversion to Catholicism and unwillingness to enforce a Protestant establishment; from unwillingness to obey an overlord to the harm of his kingdom, as with Louis Bona-

parte; from inability to face the results of crushing defeat, as with Charles Albert of Sardinia; from acceding to a higher throne, as with Charles of Naples; from shame at the results of a bad policy, as with William I. of the Netherlands; from unwillingness to retain a throne against the popular will, as with Louis Philippe — for his resignation was not enforced; or other reasons. In monarchies as a whole, the sovereign can abdicate at will; in England, only by consent of Parliament — which however, as in the case of James II., can assume an implied abdication which the monarch had no intention of executing, the term being a euphemism for deposition.

The following is a list of some of the chief historical abdications, with their dates:

Sulla the Dictator	B.C. 79
Diocletian the Emperor	A.D. 305
Benedict IX, Pope	1048
Stephen II of Hungary	1141
Ladislas III, Duke of Poland	1167
Albert the Bear of Brandenburg	1169
John Balliol of Scotland	1296
Joannes Cantacuzenos, Emperor of the East	1355
John XXIII, Pope	1415
Eric VII of Denmark and XIII of Sweden	1439
Murad II, Ottoman Emperor	1444 and 1445
Charles V, Emperor	25 Oct. 1555
Christina of Sweden	1654
John Casimir of Poland	1668
James II of England	1688
Frederick Augustus of Poland	1706
Philip V of Spain	1724
Victor Amadeus II of Sardinia	1730
Ahmed III, Ottoman Emperor	1730
Charles of Naples (on accession to throne of Spain)	1759
Stanislaus II of Poland	1795
Charles Emanuel IV of Sardinia	4 June 1802
Charles IV of Spain	19 March 1808
Joseph Bonaparte of Naples (transferred to Spain by Napoleon)	6 June 1808
Gustavus IV of Sweden	29 March 1809
Louis Bonaparte of Holland	2 July 1810
Napoleon I of France	4 April 1814 and 22 June 1815
Victor Emanuel of Sardinia	13 March 1821
Charles X of France	2 Aug. 1830
Pedro of Brazil	7 April 1831
(Also abdicated the throne of Portugal in favor of his daughter, at once on his accession in 1826.)	
Miguel of Portugal	26 May 1834
William I of Holland	1 Oct. 1840
Louis Philippe of France	24 Feb. 1848
Louis Charles of Bavaria	21 March 1848
Ferdinand of Austria	2 Dec. 1848
Charles Albert of Sardinia	22 March 1849
Leopold II of Tuscany	21 July 1859
Isabella II of Spain	25 June 1870
Amadeus I of Spain	11 Feb. 1873
Abd-ul-Aziz, Sultan of Turkey	30 May 1876
Pedro II of Brazil	15 Nov. 1888
Milan of Servia	6 March, 1889

Abdiel, ăb'dĭ-ĕl («servant of God»), the one loyal seraph in heaven, according to ‹Paradise Lost,› «among the faithless, faithful only he,» who withstands Satan when the latter is inciting revolt against God for promoting his Son over the heads of the angel peers. Milton took the name from the Jewish cabalists.

Abdomen, ăb-dō'mĕn, in human anatomy, that portion of the body bounded above by the diaphragm, below by the pelvis, behind by the lumbar vertebræ, and in front by a thin layer of muscles, the abdominal muscles. This cavity contains the chief organs of digestion and the genito-urinary system. By reason of the movements of the diaphragm it is rhythmically changing its size, and the movements of the intestines somewhat modify its internal contour. For purposes of description and for localization the abdomen is divided by a tit-tat-toe figure into nine regions; the upper and lower horizontal lines passing at the lower level of the ribs and the upper borders of the pelvis. From above downward the middle squares are termed the epigastric, the umbilical, and hypogastric; to the sides of the epigastric regions are the right and left hypochondrium (under the ribs); the right and left lumbar flank the central umbilical region, and the right and left iliac regions lie down in the pelvis on either side of the hypogastric area. The general location of the abdominal viscera in the various areas is of interest. The liver lies up under the ribs in the right hypochondrium, stretching over the upper part of the epigastrium into the left hypochondrium; the stomach lies mostly in the left hypochondrium and reaches into the epigastrium just below the sternum; the large intestine starts in the right iliac region, the appendix being there also, goes up the right lumbar into the lower portion of the right hypochondrium, crosses straight over, dipping slightly into the umbilical region, from the left hypochondrium it descends into the left iliac region and then turns back into the centre and ends at the rectum. The small intestine occupies most of the umbilical region, extending out into the others. The pancreas lies just behind the lower end of the stomach in the epigastrium. The spleen lies higher up on the left side behind, resting on the 10th and 11th ribs. The kidneys are behind high up, in the hypochondriac lumbar region, just coming below the free borders of the ribs; most pains in the small of the back thought to be kidney pains are pains from constipated bowels; kidney pains are high up under the ribs behind. The genital organs lie in the hypogastric and right and left iliac regions, the bladder low in front in the centre, the uterus slightly above in the centre, the ovaries to the right and left in the right and left iliac fossæ.

In entomology, the whole body of an insect behind the thorax. It usually consists of rings or short hollow cylinders, which are united by a joint or membrane, and in some cases, as in the grub of the chameleon fly, slide upon one another like the tubes of a telescope. Sometimes it bears a sting or an ovipositor, though in the perfect insect no appendages are found.

An abdominal ring is one of two oblong tendinous openings or «rings» existing in either groin, or in the right and left inguinal regions. Through these rings pass the spermatic cord in the one sex, and the circular ligament of the uterus in the other. It is through these rings that inguinal hernia, or rupture, occurs.

Abduction, the act of abducing or abducting; a taking or drawing away, and specifically an unlawful taking. In the United States the word abduction is ordinarily applied to the illegal seizure and detention of a female for the purpose of concubinage, prostitution, or marriage. The punishment for abduction varies in the different States of the Union. The punishment in the United States is lighter than it is in England for this offense. For instance, in New York the crime is punishable by imprisonment for not more than five years, or by a fine of not more than $1,000, or by both.

In common and English law this offense is of three kinds: (1) If any person shall maliciously, either by force or fraud, lead, or take

away, or detain, any child under the age of 10 years, with intent to deprive the parents or other persons having the lawful charge of such child, or with intent to steal any article on its person; or shall receive or harbor such child, knowing the same to have been so stolen or enticed,— every such offender shall be guilty of felony, and shall be liable to penal servitude for not more than seven or less than three years, or imprisoned, with or without hard labor, for any term not more than two years. (2) If the girl is under the age of 16 years, the offender shall be guilty of misdemeanor, and being convicted thereof shall be liable to suffer such punishment, by fine or imprisonment, or both, as the court shall award. (3) If any person shall, from motives of lucre, take away or detain against her will, any woman having any interest, present or future, in any real or personal estate, with intent to marry or defile her, or to cause her to be married or defiled by any other person, every such offender, and every person counseling, aiding, or abetting such offender, shall be guilty of felony, and liable to penal servitude for life, or for any time not less than three years, or to be imprisoned, with or without hard labor, for any term not exceeding five years. If the woman first consent to be taken away, and afterward refuse to continue with the offender, and he forcibly detain her; or if she be forcibly taken away and she afterward consent to her marriage or defilement; or if she be taken away with her own consent, obtained by fraud or imposition, the offense is the same. But if a man, without fraud, deceit, or violence, marries a woman under age, without the consent of her father or guardian, that act is not indictable at common law.

In logic, abduction is a form of reasoning in which the greater extreme is contained in the medium; but the medium is not so evidently in the lesser extreme. Example: « Whatever God has revealed is certainly true; now God has revealed a future retribution; therefore a future retribution is certainly true.» In the use of this kind of reasoning the minor proposition must be proved to be contained in the major.

Abductor, a muscle, the office of which is to draw a limb or portion of a limb to which it is attached away from the centre of that limb. Abductor of the thigh, for example, raises the thigh away from the centre of the body.

In law, a person guilty of abduction.

Abd-ul-Akhad-Khan, ābd-ool-äĸ-äd'ĸan, amir of Bokhara: b. 1852; succeeded his father Muzaffar 12 Nov. 1885, and without trying to throw off Russian suzerainty abolished slavery and underground prisons, reduced the army, regulated taxes, and proved himself an able and progressive ruler.

Abd-ul-Aziz, äbd-ool-a-zēz', 32d Sultan of the Ottoman Turks: b. 9 Feb. 1830; succeeded his brother Abd-ul-Medjid (q.v.), 25 June 1861; d. 4 June 1876. At first he showed himself liberal-minded and open to Western ideas, and promised economy and reform. But ere long he began to spend vast sums on his army, the embellishment of his capital, hunting, and costly journeys. Despite this, reforms were long hoped for, especially after his visit to western Europe in 1867. His government had great difficulties to contend with in the Cretan insurrection of 1866, the struggle of Rumania and Servia for full autonomy, and finally the outbreak of Mohammedan fanaticism. In 1871 the Sultan strove to get the succession settled upon his son, instead of his nephew Murad according to Turkish custom. He next tried to set Russia against the other powers, and plunged ever into deeper financial difficulties, while his stupid misgovernment alienated the provinces and led in 1875 to risings in Bosnia, Herzegovina, and Bulgaria. At last a conspiracy forced him to dismiss his ministers, and next to abdicate the throne, 30 May 1876. Four days later he was found dead. He was succeeded by his nephew Mehemet Murad, who was shortly deposed on the ground of alleged insanity, in favor of the present Sultan, Abd-ul-Hamid, and murdered.

Abd-ul-Hamid, I., äbd-ool-hä-mid', Sultan of Turkey, son of Ahmed III.: b. 1725; succeeded his brother Mustapha III., 1774; d. 1789. He was involved in two wars with Russia, and the treaty of Kutchuk-Kainardji in 1774 compelled him to relinquish the Crimea and other districts; and in 1788 Ochakov, in the Kherson district, was taken by the Russians.

Abd-ul-Hamid II., 34th Sultan of the Ottoman Turks: b. 22 Sept. 1842, second son of Abd-ul-Medjid; acceded 1876 on the deposition of his brother Murad V. At this time the insurrection of Bosnia and Herzegovina was in full blaze, and the intolerable misgovernment in Bulgaria by the local zaptiehs and others was preparing that province to follow suit — the desire of the people for security of life, property, and female honor being of course accredited to « Russian intrigues,» no other cause being adequate. Internally, the « Young Turkey » party, headed by Midhat Pasha — which wished to free Turkey from its European leading-strings, but by honest reforms and a parliamentary system — were equally obnoxious to him as reformers and as revolutionists. The storm of Oriental butchery and outrage he turned loose on a Bulgarian district (see BATAK) roused the Russians to a frenzy of rightful horror which forced the hand of the Czar, who did not wish war; and in the conflict of 1877–8 the Russian armies advanced almost to Constantinople. Christian Europe would perhaps have been nearly freed from the Turkish incubus, which has blighted every land it has rested on, but that the great powers flamed out in jealousy of Russia: the English Tories were barely restrained from making war on her and leaving Turkish power over the provinces just as it was, by the Liberal uprising headed by Mr. Gladstone. Even the Treaty of San Stefano (q.v.), which Russia exacted from Turkey, was not allowed to stand, the Berlin Congress (q.v.) cutting down the Turkish sacrifices; even so, however, Servia, Rumania, and Montenegro were freed altogether from Turkish suzerainty, Bosnia and Herzegovina were handed over to Austria, and Bulgaria was left in only nominal dependence, though by a futile contrivance divided into two provinces which shortly reunited; a small part of Armenia was also ceded to Russia. The treaty obligated the Sultan to introduce reforms into the remaining Christian provinces, as if the history of the previous half-century had not shown what that meant even with a sincere Sultan; and Abd-ul-Hamid had

no design of paying any attention to it. He was a bigoted Mussulman of the very party which had nullified all the efforts of Mahmud II., Abd-ul-Medjid, and Reshid Pasha, and believed that infidels should have no choice but slavery or the sword, according to the Prophet's word. He set himself at once to recover the fullest autocracy at home and evade the demands of the Christian states abroad. Midhat was shortly arrested, nominally for the acts that had given the Sultan his throne, banished, and died soon and suddenly. All power was centred in the seraglio at Constantinople, wholesale murders and terrorism cowed all opposition, and for many years no whisper of constitutionalism has been heard in Turkey. The European powers were astutely set by the ears to prevent each other from gaining any advantage of it; the Christians were treated worse than ever; finally, in 1895-6 the signal was given to let loose on all Armenia the horrors which in one spot of Bulgaria had cost Turkey half her European possessions less than twenty years before. Abd-ul-Hamid had done his work well: no abler diabolic statesman has existed in our era. Not a power lifted a finger: even the English Liberal ministry, though England had forced Russia to leave Armenia to Turkey by guaranteeing good government for it, raised no hand to protect it. A considerable percentage of the Armenians were exterminated by hordes of savage Kurds and other irregulars, with indescribable details of outrage and torture; and the Sultan found himself raised to such consideration in Europe that he shortly attempted to evade payment of a small Austrian debt, when Count Goluchowski threatened to bombard Smyrna, an effective proceeding which secured a prompt settlement of the debt. In 1897 Crete again rose, and Greece took her part, in the expectation of European help; but the time had gone by. In the ensuing war with Turkey she was not only beaten but disgraced; Europe, however, had the grace not to allow Turkey to resume sovereignty over any Christian land. Shortly after, Abd-ul-Hamid was imprudent enough to let some Englishmen be murdered, and the Powers took Crete from him and gave it a separate government. The basis of his internal power has been his championship of orthodox Mussulmanism: he claims the literal caliphate.

Abdullahi. See KHALIFA, THE.

Abd-ul-Latif, äbd'ool-lä-tēf', eminent Arab writer: b. Bagdad, 1161; d. there 1231. By way of education he committed to memory the Koran, the chief poets, and not a few grammatical treatises. He studied medicine and practised till 1185, when to complete his culture he betook himself to Damascus, where the famous Saladin had gathered round him the most learned men of the time. After the death of Saladin, who had liberally assisted him, he went to Cairo, delivered lectures on medicine and other sciences, and published an excellent description of Egypt, still extant and keeping his fame alive: translated into Latin by White (Oxford 1800), and into French by De Sacy (1810). He died at Bagdad in 1231, on his way to Mecca.

Abd-ul-Medjid, äbd-ool-me-jēd', 31st Sultan of the Ottoman Turks, son of Mahmud II.: b. 23 April or 6 May 1823; acceded 1 July 1839; d. 25 June 1861. He received the usual enfeebling harem education, his father failing in his efforts to rescue his children from the system. On his accession Turkish affairs were critical. The great viceroy of Egypt, Mehemet Ali, had a second time revolted; ten days previously the Turkish admiral had turned traitor and put the entire fleet in his hands; and three days afterward Mehemet's son Ibrahim, the greatest Moslem soldier of the century, had routed the Turkish army at Nizib, and was marching straight on Constantinople, where the orthodox party, enraged at Mahmud's reforms, had conspired to place Mehemet Ali on the throne. But the European powers interfered, and the treaties of 27 Nov. 1840 and July 1841 confined Mehemet to Egypt again. Abd-ul-Medjid at once set about complying with his father's express instructions and carrying out his reforms: 3 Nov. 1839 he promulgated the «Hatti-sherif of Gulhané,» placing all his subjects on full religious and civil equality, and providing for security of life and property to all, with just and equal taxation, administration of laws, and conscription; February 1856, after the Crimean war, it was supplemented by another to the same purport. But the Mussulman aristocracy and the educated classes (Ulema) regarded it as an anti-Mussulman revolution to no profit but that of the infidels, and fought it so furiously that it remained practically inoperative, and rather sharpened the edge of their ill-treatment of the Christians; and repeated conspiracies were formed against his life, whose members however the kindly Sultan would not put to death. His right hand in reform work was the able and humane Reshid Pasha, a Mussulman educated in France: through him the army was reorganized 1843-4; a board of education instituted 1846; a university founded, with military, medical, and agricultural colleges; a hateful capitation tax abolished, slave-trading repressed, and commerce advanced. Nothing can better prove the intrinsic and hopeless rottenness of the Mussulman system under modern conditions than the fact that these measures were written in water and died almost with their birth; their main fruit was bloody insurrections in various parts of the empire, of which the great Syrian massacres of 1860 (see SYRIA) were the worst. In 1849 Abd-ul-Medjid honored himself by boldly refusing to surrender Kossuth and the other Hungarian refugees, after the failure of the Hungarian revolution, at the joint demand of Russia and Austria. For the Crimean war, and its antecedents and results, see that head. In later life he sunk into extravagance and sensuality; but he was essentially a good-hearted and honorable man, powerless against fate. He was succeeded not by one of his seven sons, but by his brother Abd-ul-Aziz, the oldest living member of the house of Othman.

Abd-ur-Rahman, äbd-oor-rä'man, sultan of Fez and Morocco: b. 1778; succeeded his uncle 1823; d. 1859. His first four years of rule were occupied in quelling insurrections. Next, Austria refused to pay the tribute for safety against pirates levied by Morocco on European ships in the Mediterranean: the Sultan wisely adjusted the dispute by relinquishing this blackmail. (See MOROCCO.) The religious war under Abd-el-Kader against the French in Algeria involved Morocco in its movements: the defeat

by the French in 1844 compelled the Sultan to order Abd-el-Kader to quit the country, which, however, he did not for three years longer. The piratical habits of the Moroccans brought him to the brink of war with more than one European State. He was succeeded by his eldest son, Sidi-Mohammed (1859–73).

Abd-ur-Rahman-Khan, äbd-oor-rä'man-hän, amir of Afghanistan, son of Afzul (uf-'zool) Kahn, nephew of the amir Shere Ali, grandson of Dost Mohammed: b. Kabul, 1844; d. 3 Oct. 1901. During the civil war of 1864 in Afghanistan (q.v.) between Dost Mohammed's sons, he played a leading part on his father's side against his uncle, won several battles,— the important victories of Shaikhabad and Khelat-i-Ghilzai were mainly due to his ability,— and for a time his father seemed secure of the amirate; Abd-ur-Rahman was made governor of Balkh, and won great popularity by his moderation and by marrying the daughter of the chief of Badakhshan. In 1868, however, Shere Ali gained the mastery, and the English government helped to put down further resistance for order's sake. Yakub-Khan drove out his cousin Abd-ur-Rahman, who after hunted wanderings reached Russian territory, and Gen. Kaufman allowed him to live at Samarcand with a pension of 25,000 rubles a year. Here he remained till 1879, when Shere Ali's death, and the weakness of Yakub, whom the English had recognized as amir, gave him a chance to return to Balkh, where he was welcomed. The murder of the British Resident at Kabul and Yakub's deposition followed; Abd-ur-Rahman came forward once more, and was acknowledged amir by the principal chiefs and the English government, which gave him a subsidy of £160,000 a year, and large gifts of artillery, rifles, ammunition, etc. In 1893 the Indian government turned over to him Kafiristan, in the Hindu-Kush mountains, and he brought its savage tribes under control in 1896. The English government showed him great honor, as he deserved; and made him G.C.B. and G.C.S.I. He was succeeded by his eldest son, Habibullah-Khan, who had been associated with him in the government for some time.

A Becket, Thomas. See Becket, Thomas Á.

Abeel, David, American missionary: b. New Brunswick, N. J., 12 June 1804: graduated at Rutgers, studied theology, and held a pastorate in Athens, N. Y., 1826–9; resigned from failing health, and went to China, October 1829, as chaplain for the Seamen's Friend Society, and in 1830 for the A. B. C. F. M. He visited Java, Singapore, and Siam, studying Chinese; his health again failing he started for home 1833 by way of Europe, giving addresses on the claims of the heathen in Holland, France, and Switzerland, in England forming a society to promote Eastern women's education, and in America publishing works on similar subjects and his Chinese experiences. In 1839 he revisited Malacca, Borneo, and parts of Asia, and in 1842 established a mission at Amoy. In 1845 his health failed finally, and returning he died in Albany in 1846. He was one of the ablest, most practical, and most successful of early missionaries. See 'Life' by G. R. Williamson (N. Y. 1848).

Abel, John J., American physiological chemist: b. Cleveland, Ohio, 19 May 1857. He was graduated at the University of Michigan in 1883; studying abroad, he took M.D. at the University of Strasburg in 1888. He has devoted himself to the chemistry of the human body, and is professor of pharmacology in Johns Hopkins, as well as in charge of the department of physiological chemistry.

Abelard, ăb-ę-lär (Fr. **Abélard,** ăb-ā-lär), **Pierre,** pē-ār, a distinguished philosopher, and lover of Héloïse. His real name was Pierre de Palais, the other being a nickname spelled in many other ways, but originally Bajolardus, "bacon-licker," from a school joke, which he changed to Habelardus, "bacon-haver," as a retort: b. 1079 near Nantes, in the little village of Pallet, the property of his father Berenger; d. 1142. Full of intellectual enthusiasm, he gave up his patrimony to his younger brothers to devote himself to a life of study. Those studies were very wide, though the usual inclusion of Greek and Hebrew is an error; but his chief passion was philosophy, and its great implement, the scholastic logic, in which he soon became the most eminent master of his age. Having learned all that Brittany could teach him, he went to Paris, the university of which attracted students from all parts of Europe. Guillaume de Champeaux, a follower of Anselm and an extreme Realist, was the most skilful disputant of his time, and Abelard, profiting by his instructions, was often victorious over his master in contests of wit and logical acumen. The friendship of Champeaux was soon succeeded by enmity; and Abelard, who had not yet completed his 22d year, removed to Melun, whither he was soon followed by a multitude of young men, attracted from Paris by his great reputation. Hostility still pursued him, but he left Melun for Corbeil, nearer the capital, where he was still more admired and persecuted. Soon after he ceased teaching to recruit his strength, and after two years returned to Paris and found that his former teacher had removed to a monastery outside the city.

He again joined issue with him and gained so complete a triumph that he opened in Paris a school of rhetoric, the fame of which soon deprived all the others of their pupils. Shortly afterward he was appointed to his rival's chair in the cathedral school of Notre Dame, where he educated many distinguished scholars, among whom were the future Pope Celestin II., Peter of Lombardy, bishop of Paris, Berenger, bishop of Poictiers, and St. Bernard.

At this time there resided close to Notre Dame, a young lady, by name Héloïse, niece to the canon Fulbert, then of the age of 17, and remarkable for her beauty, genius, and varied accomplishments. Abelard became inspired with such violent love for Héloïse as to forget his duty, his lectures, and his fame. Heloïse was no less susceptible. Under the pretext of finishing her education he obtained Fulbert's permission to visit her, and finally became a resident in his house. His conduct in abusing the confidence which had been placed in him opened the eyes of Fulbert. He separated the lovers, but too late. Abelard fled with her to Brittany, where she was delivered of a son, who died early. Abelard now resolved to marry her secretly. Fulbert gave his consent, the marriage

was performed, and in order to keep it secret Héloïse remained with her uncle, while Abelard retained his former lodgings and continued his lectures. Abelard, however, carried her off a second time and placed her in the convent of Argenteuil.

Fulbert erroneously believed it was intended to force her to take the veil, and under the influence of rage subjected Abelard to mutilation. He became, in consequence, a monk in the abbey of St. Denis, and Héloïse took the veil at St. Argenteuil. After time had somewhat moderated his grief he resumed teaching. At the Council of Soissons (1121), no defense being permitted him, his "Essay on the Trinity" was declared heretical, and he was condemned to burn it with his own hands. Continued persecutions obliged him at last to leave the abbey of St. Denis and to retire to a place near Nogent-sur-Seine, where he built a rude hut in which he determined to live a hermit's life. Even here, however, students flocked to him, and they built him an oratory, which he dedicated to the Holy Ghost and hence called Paraclete. Being subsequently appointed abbot of St. Gildas de Ruys, in Brittany, he invited Héloïse and her religious sisterhood, on the dissolution of their monastery at Argenteuil, to reside at the above oratory, and received them there. He lived for some ten years at St. Gildas. Ultimately, however, he fled from it and lived for a time in other parts of Brittany.

St. Bernard, of Clairvaux, the leading opponent of the rationalistic school of Abelard, laid his doctrines before the Council of Sens in 1140, had them condemned by the Pope, and obtained an order for his imprisonment. Abelard appealed to the Pope, publishing his defense, and went to Rome. Passing through Cluny he visited Peter the Venerable, who was abbot there. This humane and enlightened divine effected a reconciliation between him and his enemies, but Abelard resolved to end his days in retirement. The severe penances which he imposed upon himself, together with the grief which never left his heart, gradually consumed his strength, and he died, a pattern of monastic discipline, in 1142, at the abbey of St. Marcel, near Châlons-sur-Saône. Héloïse begged his body and had him buried in the Paraclete, of which she was at that time the abbess, with the view of reposing in death by his side. In 1800 the ashes of both were carried to the Museum of French Monuments at Paris, and in November 1817 were deposited under a chapel within the precincts of the church of Monamy. The small chapel, in the form of a beautiful marble monument, in which the figures of the ill-fated pair are seen reposing side by side, is now one of the most interesting objects in the Parisian cemetery of Père la Chaise.

Abelard was distinguished as a grammarian, orator, logician, poet, musician, philosopher, theologian, and mathematician. As a philosopher he founded an eclectic system commonly but erroneously termed Conceptualism, which lay midway between the prevalent Realism, represented in its most advanced form by William of Champeaux, and extreme Nominalism, represented in the teaching of his other master, Roscellin, and largely approached the Aristotelian philosophy. In ethics Abelard placed much emphasis on the subjective intention, which he held to determine the moral value as well as the moral character of man's action. Along this line his work is notable, owing to the fact that his successors did little in connection with morals, for they did not regard the rules of human conduct as within the field of philosophic discussion. His love and his misfortunes have secured his name from oblivion; and the man whom his own century admired as a profound dialectician is now celebrated as the martyr of love. The letters of Abelard and Héloïse have been often published in the original and in translations. Pope's poetical epistle, 'Eloisa to Abelard,' is founded on them. Abelard's autobiography, entitled 'Historia Calamitatum,' is still extant.

Abercromby, David, Scottish philosopher: d. about 1702. His chief work is entitled 'A Discourse of Wit' (1686). He also wrote many treatises and his work is said to antedate the so-called Scottish School of Philosophy.

Aberdeen, 4TH EARL OF (GEORGE HAMILTON GORDON), British statesman and premier: b. Edinburgh, 28 Jan. 1784; succeeded to title in 1801; d. 14 Dec. 1860. He was educated at Harrow and St. John's College, Cambridge. Shortly after returning from a Continental and Grecian tour, full of classical enthusiasm, he established the Athenian Society; whence Byron's sneer at "the traveled thane, Athenian Aberdeen." He severely criticised Gell in the 'Edinburgh Review,' and wrote an introduction to Wilkins' translation of Vitruvius, published separately in 1822 as 'An Inquiry into the Principles of Beauty in Athenian Architecture.' In 1806 he entered Parliament as a Scotch representative peer, and was twice re-elected. In 1813 he was sent to Austria to bring it into the coalition against Napoleon, and in 1814 was a signatory of the Treaty of Prague; he won credit in diplomacy, and the same year was made Viscount Gordon in the British peerage. During 1815–28 he devoted himself to his estates. In 1828 he became chancellor of the Duchy of Lancaster, and a few months later foreign secretary in Wellington's Cabinet, and had the satisfaction of seeing Greek independence recognized. He warmly supported repeal of the test and corporation acts, and Catholic emancipation. Peel had him in both his Cabinets, 1834–5 as colonial secretary, 1841–6 as foreign secretary. In 1846, during the struggle which rent the Established Church of Scotland in twain, he brought in a compromise bill which was denounced by both halves; and after the Disruption in 1843 again attempted conciliatory measures without result. On Peel's death in 1850 he became the leader of the free-trade Conservatives. The Derby administration being unable to stand, Lord Aberdeen in 1853 formed a coalition ministry. For a time it was very popular; unluckily the Crimean war supervened. Aberdeen's tardiness of action and reluctance to enter on hostilities, the result of a constitutional aversion to war, irritated the country, which was in one of its periodical anti-Russian frenzies, and bent on fighting. Moreover, the early portion of the war was shockingly mismanaged, as those of commercial countries always are; and on the appointment of a committee of inquiry, the ministry, which had uniformly resisted the motion, resigned, and Palmerston's succeeded it. This closed Aberdeen's public

life. His dislike to "spirited" foreign policies and interference with other countries, and his sympathy with the Holy Alliance, gave him the name of an enemy to liberty; but the above detail shows its injustice.

Aberdeen, Miss., city and seat of Monroe county; on the Tombigbee River, and the Illinois Cent., the Kansas City, M. & B., and the Mobile & O. R.R.'s; 130 m. S.E. of Memphis, Tenn. Its chief trade and manufacture are cotton and cotton products, lumber coming next. Pop. (1900) 3,434.

Aberdeen, S. D., seat of Brown County, on the Chicago & N. W., Chicago, M. & St. P., and Great Northern R.R.'s; settled 1880, inc. 1882; 280 m. W. of Minneapolis, 125 m. N.E. of Pierre. It is the farming and lumber trade centre of a large section; manufactures boots and shoes, flour and feed, soap, plows, machinery, etc., and has 10 grain elevators, granite and marble works and creameries. Its factories are supplied with abundant water power furnished by artesian wells. It has national banks, several daily, weekly, and monthly periodicals, a system of graded public schools, free library, and an assessed property valuation of about $1,500,000. The mayor and city council, coöperating in most appointments, are elected biennially. Pop. (1900) 4,087; (1903) 5,572.

Ab'erdeen, the chief city and seaport in N. Scotland, fourth largest in all Scotland; lies in Aberdeenshire, 111 miles N. of Edinburgh. William the Lion gave it a charter in 1179; the English burned it in 1336, but it was soon rebuilt; within the same parliamentary boundary is a small town a mile N. near the Don mouth, the seat of St. Machar's Cathedral (1357–1527), now represented by the granite nave, which, as restored since 1869, is used as a parish church. King's College and University, founded by Bishop Elphinstone in Old Aberdeen in 1494, and Marischal College and University, founded by the Earl Marischal in New Aberdeen in 1593, were in 1860 united into one institution, the University of Aberdeen. It has 23 professors and from 800 to 900 students in its four faculties of arts, divinity, law, and medicine. The students are divided into four "nations," Mar, Buchan, Moray, and Angus. There is a lord rector, chancellor, vice-chancellor, and two secretaries. With Glasgow University, it sends one member to Parliament. Marischal College was rebuilt in 1841. King's College is a stately fabric dating from 1500, its chapel adorned with exquisite wood-carvings. In the 17th century Aberdeen had become an important place, but it suffered much from both parties in the civil wars. It has a flourishing trade and thriving manufactures; and having been largely rebuilt and extended since the formation of Union Street in 1800, the "Granite City" now offers a handsome and regular aspect. Among the chief public edifices are the county buildings, the post-office, the Market Hall, the Trades Hall, the Royal Infirmary, the lunatic asylum, the grammar school, the art gallery and art school, and Gordon's College. The last has been much extended as a technical school, the foundationers being no longer resident; while the infirmary was reconstructed and modernized to celebrate the Queen's Jubilee (1887). Of more than 60 places of worship the only one of much interest is the ancient church of St. Nicholas, now divided into the East and West churches, and having an imposing spire 190 feet high. A fine carillon of 37 bells was placed here in 1887. One may also notice the market-cross (1686), the Wallace, Gordon Pasha, and three other statues, and the Duthie public park of 47 acres. It has a large trade from the port, and good railway facilities. The chief exports are woolens, linens, cotton yarns, paper, combs, granite (hewn and polished), cattle, grain, preserved provisions, and fish. Aberdeen has the largest comb and granite-polishing works in the kingdom. There are also several large paper works near by. Wooden ship-building was formerly a prosperous industry, the Aberdeen clipper-bow ships being celebrated as fast sailers, but since 1860 they have been gradually superseded by iron or steel steamships; and, owing to its remoteness from coal and iron, its ship-building now is greatly contracted. Pop. of parliamentary borough (1891) 121,623; (1901) 153,108; 9,386 in Kincardineshire.

Aberdeen University, See ABERDEEN (Scotland).

Abernethy, John, Irish dissenting clergyman and pioneer of toleration: b. Coleraine, 19 Oct. 1680; d. 1740. The son of a Nonconformist minister, he graduated successively from Glasgow and Edinburgh universities, was licensed to preach before coming of age, urged to take an important charge in Antrim at 21, and two years later was ordained there. The work he did there for many years was of the most remarkable kind, in drafts on body, brain, soul, and will; and he was eminent in all. In 1717 he was invited at once to Dublin and Belfast; the Synod assigned him to Dublin; he refused to leave Antrim and was considered a Church mutineer; a furious quarrel followed, developing into the fight in the Irish Presbyterian Church between "subscribers" and "non-subscribers" (Abernethy's party), the latter being formally barred out in 1726. The real question at issue was of old orthodoxy versus the liberalizing opinions which he disclaimed holding, but which have of course long since left his position far behind. In 1730 he was nevertheless called to Dublin. The next year came up the question of the Test Act, really involving the whole subject of religious tests in civil life; and Abernethy took a firm stand against "all laws that, upon account of mere differences of religious opinion and forms of worship, excluded men of integrity and ability from serving their country," asserting near a century ahead of his time that a Roman Catholic could be such. His 'Tracts' were later collected, and did good service in the Catholic Emancipation fight of the next century. Abernethy was the bravest of the brave, not only in advocating unpopular truths to his own harm, but in resisting the highest dignitaries in the cause of right. See 'Diary,' 6 vols.; Duchal's 'Life'; 'History of Irish Presbyterian Church.'

Abernethy, John, the great English surgeon, grandson of the preceding: b. London, 3 April 1764; d. 20 April 1831. Educated at Wolverhampton grammar school, he was apprenticed at 15 to Sir Charles Blicke, a leading London surgeon, assistant surgeon at St. Bartholomew's Hospital; he also attended the lectures of Pott, the chief surgeon there, of John Hunter, and the anatomical lectures at London Hospital of Sir William Blizzard, who early employed him as

demonstrator. Pott, resigning, Blicke took his place, and made Abernethy assistant surgeon in 1787. His lectures drew such crowds that a special building was erected, now the celebrated St. Bartholomew's School. In 1813 he was appointed surgeon to Christ's Hospital, in 1814 professor of anatomy and surgery to the College of Surgeons, and in 1815 full surgeon to St. Bartholomew's, a post which he resigned in 1829. Of his numerous medical works the most important is 'Surgical Observations on the Constitutional Origin and Treatment of Local Diseases,' which, from his frequent references to it, became known as 'My Book.' He was one of the first to prove that topical symptoms should be treated by general remedies, especially for the stomach and bowels; and he was a persuasive and influential teacher, though over-dogmatic. He was the first to introduce the capital surgical improvement of tying the great arteries in operations for aneurism, etc. See 'Works,' 5 vols. 1820; 'Memoirs' by Macilwain, 1853, not highly esteemed.

Aberration. In physics, (1) that property of a lens or curved mirror in virtue of which it does not form a sharp, flat image devoid of false color fringes. Spherical aberration is the geometrical distortion of the image due to the fact that the surface of the lens or mirror is spherical instead of having the theoretically best form. It is easy to grind a spherical surface, and more difficult to grind those of other forms; hence in the practical manufacture of a high-grade lens the curvatures are carefully calculated, so that spherical surfaces may be used, while the spherical aberration is still kept within limits that are consistent with the use of the lens. (See LENS.) Chromatic aberration is the defect in virtue of which the focal length of the lens is not the same for all colors. A lens possessing chromatic aberration gives an image that is blurred with rainbow-like fringes; one that is devoid of chromatic aberration is said to be achromatic (see LIGHT). Mirrors, whether concave or convex, have no chromatic aberration.

(2) The slight displacement of the apparent position of a star or other celestial object, due to the fact that although the velocity of light is very great it is not infinite. In recent years much attention has been paid to aberration phenomena, because the observed amount of the displacement of a star indicates that the ether of space is stationary and that the earth passes through it like a fish through stagnant water; while direct experiments indicate, on the contrary, that the ether is dragged along with the earth to a considerable extent. See ETHER.

Ab'ert, John James, American military engineer: b. Shepherdstown, Va., 17 Sept. 1788; d. 1863. He graduated at West Point in 1811, and at once went into the War Office; was admitted to the bar; served in the War of 1812, becoming topographical engineer with the rank of major; was made chief and colonel of topographical engineers in 1838, and assisted in developing important canals and other works. His engineering reports are standard, and he was a founder of the National Institute of Science, since merged in the Smithsonian.

Abeyance, meaning expectancy; probably derived from the French *bayer*, to gape after. When real or personal properties are in expectation, or the intendment of the law, they are said to be in abeyance, or not actually possessed. The word is often used in the Church of England, a living being known as "in abeyance" when it is left vacant owing to the unwillingness of the patron to declare himself in favor of any particular applicant for the office.

Abich, Wilhelm Herman, German mineralogist and naturalist: b. Berlin 11 Dec. 1806; d. Graz 2 July 1886. After completing a course of study in the natural sciences at the University of Berlin, he traveled in Italy and Sicily. In 1842 he was appointed to the chair of mineralogy in the university at Dorpat, and in 1853 was elected a member of the Academy of Sciences in Saint Petersburg, for whom he wrote exhaustive reports of the explorations which he had made in the Caucasus, Russian Armenia and northern Persia. He also published several books descriptive of the minerals found in the different countries in which he had traveled, the most important of which are: 'Erläuternde Abbildungen von geologischen Erscheinungen, beobachtet am Vesuv und Aetna 1833 und 1834' (1837); 'Ueber die Natur und den Zusammenhang der vulkanischen Bildungen' (1841); 'Ueber die geologische Natur des armenischen Hochlander' (1843); 'Ueber die Natronseen auf der Araxesebeni' (1846–9); 'Vergleichende geologische Grundzüge der kaukas-armenischen und nordpersischen Gebirge' (1858); 'Sur la Structure et la Géologie du Daghestan' (1862).

Abildgaard, ä'bĭl-gôrd, **Nikolai Abraham,** Danish painter: b. Copenhagen 4 Sept. 1744; d. Frederiksdal 4 June 1809. He studied for some time at the academy in Copenhagen, but in 1772 went to Rome to study under the masters. After his return he was appointed to a professorship at the academy in 1786, and in 1789 was elected a director. The greater number of his paintings were of an historical nature and he had much to do with the founding of the Danish school of historical painting. A series of 10 pictures in the castle of Christiansborg, which burned in 1794, and scenes from Shakespeare and Ossian were his most important works.

Abilene, Kan., city, seat of Dickinson County, 163 m. W. of Kansas City, on the Kansas River and three railroads: Union Pacific, Chicago, R. I. & P., and Atchison, T. & S. F. R.R.'s; settled 1856, incorporated 1869, the original charter being still in force. For many years it has been one of the great agricultural market centres of the State, the focus of a large farm loan business, and the sales-ground for the large droves of cattle that are annually brought from Texas. It has also large manufacturing interests, including several flour-mills and creameries, as well as manufactures of iron bridges, carriages, etc. Mineral water from adjacent sand springs is bottled for export. The government consists of a mayor and council. Pop. (1900) 3,507.

Abilene, Tex., city, seat of Taylor County, 160 m. W. by S. of Fort Worth, on the Texas & P. R.R. The centre of a farming, cotton, and stock-raising district, its chief interests lie in its cotton-gins, flour- and feed-mills and grain elevators, although it also has flourishing manufactories of saddlery, harness, lumber, and ice. Its educational advantages are excellent, and

include a public high school and a prosperous Baptist college. Pop. (1900) 3,411.

Abingdon, Ill., city, Knox County; 85 m. N.E. of Quincy; on the Chicago, B. & Q. and the Iowa C. R.R.'s. Settled 1828, incorporated 1857, now acting under charter of 1859. Among its many industrial interests, which include wagon-works, saw-mills, and manufactories of gloves and organs, it has the largest animal-trap factory in the world. Besides its excellent school system, it is the seat of Hedding College (M. E.) and Abingdon (Christian) College, the latter having been founded in 1855. A mayor and council of five is annually elected. Pop. (1900) 2,022.

Abingdon, Va., post village, seat of Washington County; on the Norfolk & W. R.R., 315 m. S.W. of Richmond and 140 m. W. by S. of Lynchburg. Settled 1730, incorporated 1788, it has long been noted for its large tobacco and live-stock interests, as well as for its valuable deposits of iron, gypsum, and salt, much of the salt used in the Southern States during the Civil War having been obtained in this vicinity. Its manufactures include wagon-works and planing-mills, besides cigar, tobacco, and pipe factories. It is also the seat of Martha Washington College for girls, the Stonewall Jackson Female Institute, the Academy of the Visitation, and Abingdon Academy for boys. Pop. (1900) 1,306.

Abington, Mass., a post township in Plymouth County, 20 m. S.E. of Boston, on the Old Colony division of the New York, N. H. & H. R. R.R. Settled in 1680, incorporated 1712. Its southern portion is now known as Whitman; its northern portion as North Abington, and both are important manufacturing centres, the chief industries being the making of machinery, shoes, and leather goods. The government is by town meeting. Pop. (1900) 4,489.

Abiogenesis. See BIOGENESIS.

Abjuration, the act of forswearing, abjuring, or renouncing upon oath; a denial upon oath; a renunciation upon oath. Chiefly a law term and used in the following senses:

1. In the United States when an alien wishes to become a citizen he must declare among other things, that he doth absolutely and entirely renounce and *abjure* all allegiance and fidelity which he owes to any foreign sovereign, etc., and especially, by name the sovereign, etc., whereof he was before a citizen or subject.

2. An abjuration of the realm. During the Middle Ages the right of sanctuary was conceded to criminals. A person fleeing to a church or churchyard might permanently escape trial if, after confessing himself guilty before the coroner, he took an oath abjuring the kingdom: promising to embark, at an assigned port, for a foreign land, and never to return unless by the king's permission. By this, however, he forfeited his goods and chattels.

3. Special. An abjuration or renunciation of all imagined allegiance to the Jacobite line of rulers, after the English nation had given its verdict in favor of William and Mary.

The oath of abjuration was fixed by 13 Wm. III. c. 16. By the 21 & 22 Vict. c. 48, one form of oath was substituted for the oaths of allegiance, supremacy, and abjuration. For this form another was substituted by the Act 30 & 31 Vict. c. 75, § 5. This has in turn been superseded by the Promissory Oaths Act, 31 & 32 Vict. c. 72.

4. An abjuration, renunciation, or retraction of real or imagined heresy or false doctrine. Thus the now abolished 25 Chas. II. c. 2, enacted that certain tenets of the Church of Rome were to be solemnly renounced.

Ablution, or the ceremonial act of washing to symbolize purification from uncleanness, is a rite which has been observed by many races of people from the early Mosaic days down to our own time. Under the Mosaical dispensation the act of ablution had four purposes: (1) To cleanse from the taint of an inferior position before initiation into a higher state, as when Aaron and his sons, having been chosen for the priesthood, were washed with water before they were invested with their robes of office; (2) to cleanse in order to fit one for special acts of religious ceremony, as when the priests were required, under the penalty of death, to wash both their hands and feet before approaching the altar; (3) to cleanse from defilement contracted by some particular circumstance which prevented one from enjoying the privileges of ordinary life, of which there were no less than 11 species of uncleanness recognized by the law; and (4) to cleanse or absolve oneself from the guilt of a particular act, as when, in expiation for an unknown murder, the elders of the village washed their hands over the slaughtered heifer, saying, "Our hands have not shed this blood, neither have our eyes seen it" (Deut. xxi.). This practice was also common both among the Greeks and Romans, and it was undoubtedly in accordance with this practice that Pilate called for water and washed his hands to signify that he held himself innocent of the blood of Jesus Christ (Matt. xxvii. 24).

Ablution by the priests before the performance of sacred ceremonies was common even among the heathen, while the Egyptian priests carried the practice to such an extreme that they shaved their entire bodies every third day and then washed themselves in cold water twice every day and twice each night, that no particle of filth might even rest upon them. Such an act corresponds somewhat to the more simple *wadu* of the Mohammedans, a ceremonial washing which they are compelled to observe five times daily, or immediately before their stated prayers, and these do not begin to represent the formal acts of cleansing required by the Moslem law. For example, the ablution for positive defilement required by Moses has its counterpart in the Mohammedan *ghual*, and yet again, under the Moslem law, the causes of such defilement are specified so minutely that they greatly exceed those of the ancient Jews. So strict was the law upon this point, however, that, when water could not be obtained, it was required that the purification should be made with something that might represent the water. In times of drought, therefore, or on occasions of sickness, the act of purification might be performed by rinsing, or rubbing the hands and face with dry sand. This form of cleansing was called *tayemmum*.

The ceremony of ablution at communion was adopted by the early Christian Church, and has been retained both in the Eastern and Roman

Catholic Churches. In the Roman Catholic Church it has become a liturgical term, denoting the two acts of cleansing performed during the mass: (1) When wine is poured into the chalice to disengage any particles which may be left in the vessel; and (2) when both wine and water are poured over the priest's fingers into the chalice. In the Greek Church the word "ablution" is applied to a ceremony performed seven days after baptism, when the unction of the chrism is formally washed off from those who have been baptized.

Abnormal Psychology covers all considerable deviations from the typical normal mind. Normal minds like normal bodies differ much among themselves; it is therefore impossible to lay down any arbitrary rule by which variations from a type or "norm" — at least, if the variation be but slight — may be identified. A pulse rate which, in a young child, indicates health, may, in an adult, be a symptom of disease; a pallid skin which is "normal" to one individual may, in another, proceed from a deranged circulation. Similarly, emotional excitement which, for a person of sanguine temperament, is entirely "natural," may, if found in a phlegmatic individual, express a highly abnormal mental state; and what is unhesitatingly pronounced insanity in one person may, in another, be laid to eccentricity. Abnormality must, therefore, be taken as a deviation, not from a general normal type, but from a particular standard which a given class of individuals represents. Abnormal psychology is a wider term than "mental pathology" or "mental disease." It is wider because many abnormalities of mind occur in a perfectly healthy — nonpathological — condition. Deaf-mutism, for example, is no more pathological than the having of supernumerary toes and fingers. Abnormal psychology falls into three parts; the first deals with temporary derangements, the second with more or less permanent derangements (mental diseases, including insanity), and the third with defective and exceptional minds.

1. Under temporary derangements are to be classed abnormal illusions, hallucinations, dreams, and hypnosis. All these derangements indicate a loss of efficient mental functioning without, however, necessarily entailing a permanent morbid condition. In order to understand the significance of such deficiencies it will be necessary to keep in mind the more important functions which devolve upon consciousness. These are (1) perception, the correct apprehension of the external world of objects and events, (2) the appropriate reaction of the individual upon objects (for example, instinctive, impulsive, and volitional actions), and (3) the establishment and maintenance of adequate social relations with other individuals and groups of individuals (states, corporations, etc.). It is, in general, an omission, a defect, or an exaggeration, connected with one or more of these great functions, that marks the passage from a normal to a deranged state of consciousness.

Among abnormal illusions are to be found some of the slightest and least serious delinquencies of mental function; delinquencies which are analogous to the lesser and more fleeting ills of the body. Instances are furnished by the mistaken perception of ghosts and goblins under stress of strong imagination or high emotional tension, and the seeing of fantastic forms in fire, rock, and cloud. Illusions of this type may, however, rest upon other conditions; upon a general temperamental bias, or upon prejudice, or superstition, or excessive fatigue, or hunger, or upon the use of drugs, or, finally, upon disease. Hallucinations are closely related to abnormal illusions. The traditional distinction between the two has been handed down from the time of the French alienist, E. Esquirol (1838), who defined illusion as "a false perception of an object," hallucination as "a perception without an object." This distinction, though it has little psychological significance, possesses a certain value in diagnosis; for hallucinations, as thus conceived, indicate a more serious psychological derangement than illusions. A relatively small number of hallucinations depend, as a matter of fact, upon the brain alone; in most cases, a peripheral disturbance, somewhere throughout the body, is their ultimate condition. Thus the hallucinatory belief that a part of the body is dead may come from a local paralysis or the conviction that the bones are tubes of glass from deranged organic sensations. Hallucinations are far less frequent in the sane and healthy than are the illusions described above. (See PSYCHICAL RESEARCH.) They are, however, frequent accompaniments of certain nervous disorders, for example, epilepsy and hysteria, and in ecstasy, in the dancing epidemics of the Middle Ages and in demoniacal possession, hallucinations have played a prominent part; while in those forms of insanity which are accompanied by cloudiness of perception and thought (delusional insanity, paranoia, and general paralysis) they are extremely frequent. *Dreams.* The dream consciousness is chiefly a perceiving consciousness; will, sentiment, memory, and reasoning are much less prominent than in waking life. But it is, nevertheless, a consciousness which does not fulfill the normal functions of perception. Dream perceptions are "unreal," and may, therefore, be considered as derangements; although they are no more pathological in their nature than the sleeping state in which they occur. The dream state is further characterized by diffuse unconcentrated attention and by loose and scattered associations. *Hypnosis.* One degree further removed from the normal mind than the dreaming state is the state of hypnosis. The two states possess, however, certain significant points of resemblance and of difference. (1) In both, consciousness is more or less cut off from the influence of the outside world. In sleep, the avenues of sense are closed. We seek darkness and quiet, avoiding, in general, conditions which would make demands upon the organs of sense and of movement. Furthermore, the sleeping state itself tends to protect the nervous system from intrusion; the sensory paths are blocked. In hypnosis, similar conditions obtain. There is a general insensitivity of the nervous system; so that appeals from the environment are, as a rule, unsuccessful. The subject is unaware of what is going on about him. (2) Again, both in dreams and in hypnosis, certain stimuli are effective. The course of dreams is partly determined by strong or persistent appeals from

without, for example, the chirp of insects, the rumble of traffic, the chill of the room, the cramp of an uncomfortable position. The course of the hypnotic consciousness is similarly determined by the words and gestures of the operator. (3) The dream and the hypnotic consciousness share a common attitude of belief in whatever situation is presented. Capacity for discriminating the world of sense from the world of memory and of imagination is lacking to both. The individual is completely credulous. The past and the future are, for the time being, annihilated. The person lives only in the present. (4) Along with these similarities there stands a striking and a fundamental difference between dreams and hypnosis. The dream consciousness is broad and shallow. Associations run riot. The selective function of the attention which, in the normal consciousness, rejects the trivial and the accidental and fixes upon the essential features of the perception or the idea, is lacking. One thing appears as important and as valuable as another. There is no subordination. Consciousness is scatter-brained. Consequently, the dream is (as one discovers upon waking) absurd and fantastic. In hypnosis, on the contrary, consciousness is deep and narrow. Along with the general insensitiveness just noted (anæsthesia) there goes a special high sensitiveness (hyperæsthesia). The slightest sound or gesture of the operator is caught up by the subject and acted upon. This special sensitiveness — not occult power in the operator — is the secret of *rapport*. The immediate and uncritical response of the hypnotized subject is due to his own abnormal psychophysical condition and not to any "force" exerted from without. Although certain of the physiological phenomena of hypnotism are to be found in some of the lower animals, in the state of catalepsy, human hypnosis is, on its conscious side, essentially a social phenomenon. It rests upon the general fact that all persons are, even in normal life, suggestible; that is, that their beliefs are largely determined by the personal or social influence which the individual exerts over his fellows. This influence shows itself normally in a mood or intellectual attitude of acquiescence. When the mood grows strong and overpowering — as in the presence of a captivating rhetorician — it becomes the attitude of obedience, of submission to authority. Now, in the abnormal state of hypnosis, the mood of submission is heightened, by the narrowing and deepening of consciousness, to the exclusion of all contrary and inhibitory associations. The result is that the beliefs and, consequently, the actions of the subject are entirely at the mercy of the meagre perceptual processes supplied, by way of "suggestion," from the operator. Hypnosis is, then, an abnormal psychophysical state which nevertheless closely resembles, in certain prominent features, both the dreaming and the waking states of everyday life.

2. *Permanent mental derangements.*— There is no general agreement among alienists regarding the precise limits of insanity. Some alienists regard practically all classes of mental disease as falling under insanity; others restrict the term to those derangements of mind which show a distinct loss of equilibrium among mental functions. The meaning of the term is, however, approximately fixed by practical and legal considerations; an individual is often pronounced insane when his mental condition so paralyses or perverts his personal and social relations that detention and treatment in a hospital for the care of the insane appears advisable.

On the border line of mental alienation stand such derangements as hysteria, neurasthenia, and hypochondria. It is clear that these affections stand on a different plane of abnormality from dreams and hypnosis, on the one hand, and from more serious forms of insanity, on the other. They are all of interest to the psychologist (but especially hysteria) because they present typical abnormalities of development, of the state of attention, and of the functions of memory, volition and emotion. Consider hysteria. The hysterical is abnormally absent-minded. The range of her attention is exceedingly narrow, so that she may, for example, in observing an object before her eyes, become quite blind to all other objects in the range of vision. Her capacity for learning is inhibited. She suffers a partial or total loss of memory (amnesia). The will power is impaired (abulia). The patient becomes a victim to habits of automatic action and to uncontrollable emotions and moods. Hysteria furnishes, moreover, a rare field for the study of suggestion and for the analysis of personality. French psychologists, who work by preference from the abnormal to the normal mind, have recently made important contributions to our knowledge of this form of mental disease.

When we come to insanities proper, we find a bewildering number of symptoms and of diseases. Out of these we can, however, extract a few general and typical forms. These include mania, melancholia, circular insanity (all distinguished by abnormal emotions and moods), delusional insanity (distinguished by fixed, irrational beliefs of grandeur, unseen agency, persecution, etc.), volitional derangements whose various forms (destructive, homocidal, dipsomaniac, kleptomaniac, etc.), are characterized by the lack of voluntary control, and, finally, a class of mental diseases which present the most complete and general loss of function — the highest degrees of mental abnormality. This class includes general paralysis, amentia, and dementia.

3. *Defective and exceptional minds.*— Our third class of abnormality covers (1) minds that are lacking in certain simple processes common to all normal individuals (the mind of the congenitally blind and congenitally deaf, the color-blind, and persons suffering from various impairments of the function of speech), (2) minds in which some set of processes or some function is abnormally developed (phenomenal chess-players, "lightning calculators," and trance "mediums"), (3) the genius, (4) the habitual criminal, the sexual pervert, and other "degenerates."

The deficient minds of (1) are of interest to the psychologist inasmuch as they show, by their very deficiency, the part played, in consciousness at large, by the lacking elements. The comparison, that is, of a normal mind with a mind wanting in visual or auditory sensation or verbal imagery is important for the psychology of vision or of audition or of language. The comparison is useful also in a study of mental substitution; for the functions of memory, imagination, and social communication

ordinarily borne by visual, auditory and motor imagery must, in the affections named, be borne by other mental processes. Finally, the mental aberrations to be found in the habitual criminal and the pervert bring the psychologist back to the domain of mental pathology and, at the same time, they offer material for investigating the influence upon mental constitution of hereditary tendency.

Consult: Parish, 'Hallucinations and Illusions' (1897); Nordau, 'Degeneration' (trans. 1895); Galton, 'Hereditary Genius' (1887); Mercier, 'Sanity and Insanity' (1890); 'Psychology, Normal and Morbid' (1901); Janet, 'The Mental State of Hystericals' (trans. 1901).

I. M. Bentley,
Asst. Prof. of Psychology, Cornell University.

Abolitionists, the extreme section of the anti-slavery party in the United States, who advocated immediate sweeping away by the national government of Southern slavery, without regard to constitutional guarantees, vested interests, or political facts; this section and its nickname date from about 1835. Gradual abolition had been the desire of many of the best men even of the South; and till after the War of 1812 there was no prejudice against the freest expression of opinion on the subject. But the effects of Whitney's cotton-gin were now beginning to be felt in making the slave system for the time enormously profitable; and the Missouri Compromise, with the insistence of the South thereafter that States should be admitted only in pairs, one slave and one free, showed that the time of apathy had gone by. The new zeal of the South in upholding, increasing, and justifying the system was met by a new intensity of the North in opposing it, though for a long time confined to a small band of agitators. In 1833 the National Anti-Slavery Society was formed in Philadelphia; in 1831 William Lloyd Garrison had founded the *Liberator*, a weekly continued till 1866, filled from the first with the fiercest denunciation not only of the system but of all connected with it; and a brilliant band of orators, philanthropists, and growing political forces,— Wendell Phillips, Charles Sumner, Gerrit Smith, and women like Lucretia Mott,— kept the public mind on the alert and furnished a monotonous moral to the course of political events which the people might not otherwise have drawn so readily. There were grades even among these; and the extremists denied the duty of obeying the United States Constitution, since it contained the clause warranting the fugitive slave law, which was denounced as "a covenant with death and an agreement with hell." In practice they violated it systematically by assisting in the escape of runaway slaves, through the machinery known as the "Underground Railroad," concealing them from pursuit and forwarding them from stage to stage till they reached Canada. But in 1840 the abolitionists divided on the question of the formation of a political anti-slavery party, and the two wings remained active on separate lines to the end. It was largely due to the abolitionists that the Civil War, when it came, was regarded by the North chiefly as an anti-slavery conflict, and they looked upon the Emancipation Proclamation as a vindication of this view. See Anti-Slavery Society; Liberty Party; Slavery; United States — Causes of the Civil War.

Aborigines (Lat. "from the origin"; the Greek name was *autochthonoi*), the earliest inhabitants of a country discoverable by civilized investigation. Their relation to the animal world as a whole comes under the head of Anthropology; to other races, under Ethnology; their culture and conditions, under Archæology; of special countries, under their names, or those of particular tribes. Specifically, in Roman writers, a race traditionally said to have been driven by the Sabines from their first homes in the mountains around Reate (Rieti), invaded Latium, subjugated the native Siculi and occupied the land, along with a tribe of Pelasgi, the two thenceforth taking the name of Latini. If true, these Aborigines would be of Oscan stock and form the non-Pelasgian element in the Romans.

Abortion, the expulsion of a fœtus from its natural resting-place before it is capable of carrying on its own life. A variety of different terms have been applied to indicate variations in the character of this process; thus: accidental, when brought about by purely accidental means; artificial or induced, when caused for medical therapeutic reasons; criminal, when induced for social rather than medical exigencies; tubal, when rupture of the Fallopian tube occurs, discharging the fœtus into the abdominal cavity, the pregnancy being extra-uterine.

The causes for this accident, apart from induced abortion, may be due to paternal, maternal, or fœtal defects. The proportion of abortions to full-time pregnancies is about 1 to 7 or 10. Of the paternal causes, alcoholism, syphilis, old age, or physical weakness may be cited. The most frequent causes, however, are of fœtal and maternal causes. Death of the fœtus is the most frequent fœtal cause. The maternal causes may be local or constitutional. Inflammation of the membranes of the uterus, tumors or new growths of the uterus, disease of the ovary, and inflammatory adhesions of the closely associated organs, act as local causes. Alcoholism, starvation, as in times of famine, syphilis, lead poisoning, coal-gas poisoning, acute diseases, as typhoid, pneumonia, and sudden severe shock, are the most common agents acting on the mother that bring about the death of the fœtus and its subsequent expulsion.

The symptoms are hemorrhage, discharge of the amniotic fluid, and pain. The treatment is always medical. The dangers are mostly those of hemorrhage and blood-poisoning.

In law, when abortion is produced with a malicious design, it becomes a misdemeanor, and the party causing it may be indicted and punished. When, in consequence of the means used to produce abortion, the death of the woman ensues, the crime is murder. In all cases of abortion the body of the offence must first be proven. The fact of the pregnancy, the use of the instruments, and the administering of the drugs must be established beyond a doubt. The evidence of the woman upon whom the abortion was committed is admissible but her dying declarations are not admissible unless homicide is charged. A person who sells a drug or instrument, knowing that it is to be used for the purpose of causing a miscarriage, is also guilty of a misdemeanor.

Abra, ā'-bra, a province and a river in the N. of Luzon, Philippine Islands. The province contains numerous deposits of placer gold, and the river gravel is auriferous. Other minerals, such as coal, copper, lead, iron, and sulphur, are believed to exist in paying quantities, as Luzon is known to be rich in these and other economic minerals. For its head-hunting tribes, see IGORROTE; PHILIPPINES.

Abraham or **Abram,** the progenitor of the Hebrews and the Arab Bedouin. After deriving his genealogy through Shem to his father Terah and his brothers Nahor and Haran, the narrative in Gen. xi.–xxv. proceeds as follows,— each step in the pilgrimage being by express direction of Yahwé, to his purpose of founding the Hebrew nation:—

After Haran's death Terah removes with his family from his native Ur of the Chaldees (? Mugheir in southern Babylonia), north to Haran, where he dies. Abram then (at 75) takes his wife Sarai and his nephew Lot, Haran's son, and makes his way north by way of Damascus (stopping to build altars to Yahwé at Shechem and Bethel) to Canaan, where he receives the promise that he shall become the founder of a great nation, and all the families of the earth shall be blessed in him. Being a pastoral nomad, a drouth in Canaan forces him to seek forage in fertile Egypt; where he passes off Sarai as his sister, in fear that her beauty will lead to his murder to possess her, and she is taken by Pharaoh, who, on discovering the deception, restores her, but orders Abram out of Egypt. Accompanied by Lot, he returns to a former encampment between Bethel and Ai. The clans of the two kinsmen quarrel over the limited pasturage, as usual with nomad tribes, and Abram proposes that each follow his own fortune. Lot, wishing to quit nomad life, chooses the fertile Jordan plain; Abram pitches his tent among the oak groves of Mamre, close to Hebron, and the previous promise of his posthumous glory is repeated and solemnly covenanted. Lot is captured in a raid of the Babylonian king, with his Syrian and other allies, against his revolted vassals of the Dead Sea and Jordan valleys, including the kings of Sodom and Gomorrah, who are overthrown; Abram sallies out to his rescue with a band of tribesmen, beats the confederacy and chases them near to Damascus, and not only recovers his nephew but restores the above kings to their thrones, refusing any reward. The property of the childless Abraham is to descend to his trusted servant Eliezer, and Sarai suggests that he avoid this by having a child from a concubine, a common enough arrangement; accordingly he has Ishmael by Sarai's maid Hagar, at 86. Four years later it is revealed by Yahwé in person to Abram that he shall have a legitimate son by Sarai, whose name is thenceforth to be Sarah (princess) and his own to be Abraham (father of peoples); the promise is afterward repeated by Yahwé and two angels, who visit Abram's tent in human form, the latter going on to destroy Sodom and Gomorrah for their wickedness, and the former staying behind to inform Abram of it. Abram's plea wins a promise of mercy contingent on ten righteous men being found there, but they are not forthcoming, and only Lot and his family escape. Abram goes to Gerar (Negeb) in southern Palestine, repeats precisely the same performance with the nonagenarian Sarai as before, and the king Abimelech repeats the part of Pharaoh, with the same apologies and reproaches. Isaac is born, Sarah being 90, and Hagar and her boy Ishmael are driven into the desert by Sarah's jealous fears, where Ishmael becomes ancestor of the Bedouin. Isaac is circumcised at eight days old, as a token of Yahwé's covenant with Abraham. Some time in Isaac's boyhood Abraham is commanded by Yahwé to make a burnt-offering of him, and proceeds to obey, but is spared the sacrifice by Yahwé, who accepts a stray ram instead and blesses him for his faith. Sarah dies in Hebron and is buried in the cave of Machpelah, which Abraham buys of Ephron the Hittite. He later marries Keturah, has six sons by her, dies at 175, and is buried beside Sarah. Isaac has previously married Rebekah, so that the succession is assured.

The Jewish stories of Abraham were by no means confined to this account in our canonical book; they had many others, associating him with Nimrod, etc., which are collected in the Talmud; and the Mohammedans invented or preserved many more. The critical view is that there was a real Abram or Abraham (the traditions existing in both forms), with his home at Hebron, probably a considerable man from the number and persistence of the legends about him; but that this is all we know. The names of his brothers and ancestry are not persons but Arab clans, and their relations and movements represent what was handed down or believed concerning the North-Arab league that grew into the Hebrew nation, or its original elements. The path of the "bne Terah" from the southern Euphrates valley into Palestine and elsewhere is certainly a correct type of the actual course, as revealed to us by archæology, of the Semitic tribes who century after century poured out of the Arabian deserts, into and up through western Mesopotamia, to plunder or share the rich Babylonian civilization and wealth, as the barbarians did that of the Roman empire; according to the resistance they found they stayed in the Moabite district, turned west to overrun the Jordan valley, or moved north into Syria. For the archæological results see the chapters on early times in various histories of the Hebrews, Kittel's, Stade's, Guthe's, etc.; Sayce's 'Patriarchal Palestine' and 'Early History of the Hebrews,' reverent in tone; Tompkin's 'Studies on the Times of Abraham.' Critical commentaries on Genesis are also serviceable. For the rabbinical legends, the sources — in German — are Beer on the life of Abraham, and Grünbaum on the 'Semitic Sagas,' which gives the Mohammedan legends likewise.

Abrahamites, (1) A 9th-century sect of Syrian deists, denying the divinity of Christ. (2) In modern use, the Bohemian deists of the later 18th century, who called themselves followers of Huss, but accepted no religious doctrine beyond the unity of God, and nothing of the Bible but the Lord's Prayer. They avowed this creed in 1782 on Joseph II.'s promise of toleration; but as they would join neither Jewish nor Christian folds, he expelled them from Bohemia the next year and scattered them through Hungary, Transylvania, and Slavonia. Many were martyred, others turned Catholic.

Abram. See ABRAHAM.

Abrasives, or those substances used in grinding or polishing, include (*a*) mineral substances, such as grindstones and whetstones, which are used by simply shaping up the material found in nature; (*b*) mineral substances which occur disseminated in the rocks or which must first be freed from impurities and are prepared for use by an initial pulverization; (*c*) artificial abradants. The history of abrasives shows that in ancient times the first class was most largely used, while the artificial abrasives now so extensively employed, were unknown until quite recently.

(*a*) *Oilstones and Whetstones* (q.v.) are largely American products. For nearly a century New Hampshire has been the headquarters of the whetstone industry. Whetstone rock is also found in Vermont, Massachusetts and Indiana. The best oilstones from New Hampshire are inferior to those of Garland County, Arkansas, in which region there are extensive beds of a remarkably compact, white, Paleozoic quartz rock, called Novaculite. Griswold in 1890 announced that this material is a sedimentary deposit of fine-grained quartz and not a chemically precipitated deposit as had been previously supposed. The quarries were largely worked for implements in prehistoric times and since 1840 they have yielded the finest oilstones known. These are sold under the names of «Washita» and «Arkansas» oilstones. The production of oilstones and whetstones in the United States during 1902 amounted to $221,762. The imports, chiefly of razor hones from Belgium and Germany, and of «Turkey» oilstones from Italy and France amounted to $56,456. Grindstones are manufactured from a tough, gritty sandstone, found chiefly in Ohio, though Michigan, Montana, Wyoming, and West Virginia add to the output, and England, Scotland, and Bavaria are also producers. The production of grindstones in the United States in 1902 amounted to $667,431. Millstones and buhrstones are far less used now than before the introduction of the roller process of making flour, for while the American production in 1880 amounted to $200,000, it fell in 1894 to $13,887. Since 1894 it has steadily increased till in 1902 it was $59,808. This is owing to the increased demand for buhrstones for grinding the coarser cereals, fertilizers, cement rock, and various minerals. Millstones are finer grained and more compact than grindstones. They are usually made from sandstone or a quartz conglomerate. The buhrstone (q.v.) from France is the best, but the stones from New York, Pennsylvania, and Virginia meet most of the requirements of the trade.

(*b*) *Pumice* (q.v.), a spongy lava, or a volcanic ash, is used in scouring powders and soaps. It comes chiefly from the Lipari Islands, but is also produced in Utah and Nebraska. Infusorial or diatomaceous earth occurs in beds often miles in extent. It is formed of the siliceous shells of infusoria and diatoms, and is used in scouring soaps and powders. The chief American localities are in Maryland, Virginia, New Hampshire and California. Tripoli is a similar variety of opal, but formed from a siliceous limestone by the leaching out of the calcium carbonate. Its use as an abrasive is as a polishing powder for metals, etc., but it is also extensively manufactured into filters, for which it is admirably adapted. Extensive deposits are worked at Seneca, Missouri, but the chief supply is imported from Tripoli. Crystalline quartz, of which over 15,000 tons were mined in Connecticut and Pennsylvania in 1902, is used as a wood finisher, in the manufacture of sandpaper, in the sawing of marble, for cleaning castings, etc. Garnet (q.v.) occurs in many of the crystalline rocks, especially in pegmatite and mica schist. Many varieties are recognized by the mineralogist; but the value of garnet as an abrasive, aside from its great hardness, is dependent not on its composition, but on its structure. If this is distinctly lamellar the material will continually present the sharp edges which are so essential to a good abrasive. Garnet which lacks this lamellar structure is of comparatively little efficiency for grinding and smoothing. Garnet-paper is much superior to sandpaper and is extensively used in woodworking and finishing the soles and heels of shoes. The most important localities are in New York, Connecticut, Pennsylvania, and North Carolina. Corundum (q.v.), being the hardest mineral known, except the diamond, ranks next to it among the natural abrasives. It occurs in enormous quantities in Ontario, which since 1901 has been the leading producer. It is also extensively mined in Montana, while North Carolina and Georgia have until very recently furnished nearly all of the domestic supply. Small quantities of corundum are produced in India which go chiefly to the English market. Emery (q.v.) is a natural mixture of corundum with magnetite or hematite. It has been largely mined at Chester, Mass., and Peekskill, New York. The chief supply, however, comes from the Island of Naxos, Greece, and from Asia Minor. The material is brought to this country as ballast and owing to the low prices at which it is marketed, the sale for the American mineral is much reduced. Diamond, owing to its far greater hardness, brings many times the price per carat which any other abrasive brings per pound. The black amorphous «carbonado» found in Brazil is much harder than the crystallized diamond, but it is almost exclusively used for diamond drills, while the dust of the South African «bort» is the material commonly employed as an abrasive in the cutting of diamonds and other precious stones.

(*c*) Among artificial abrasives, carborundum (q.v.) holds first rank. Discovered in 1890, its production has steadily increased from 1,000 pounds valued at $15 per pound in 1893, to 3,741,500 pounds valued at 8 to 10 cents per pound in 1902. It is generally acknowledged that it is exceeded in hardness only by the diamond, thus ranking above pure corundum. The chief objection to it is its brittleness. Carborundum wheels and stones, as well as carborundum cloth and paper, are now active competitors of the similar manufactures of emery and corundum. Crushed steel is extensively used in sawing, grinding, rubbing, and polishing marble, granite, and other stones, while the finer grades of crushed steel, known as «steel emery» and «rouge» are used in grinding glass. Artificial corundum is now being manufactured at Niagara Falls by heating the mineral bauxite in the electrical furnace.

For further particulars about abrasives see 'Mineral Resources of the United States,' published annually by the United States Geological Survey.

George Letchworth English,
Mineralogist, New York City.

Absalom, third son of King David (2 Sam. xiii.–xv., xviii.; 1 Chron. iii. 2). He revenged his brother Amnon's outrage of his sister Tamar by killing him, and was banished from his father's court for five years. The grudging re-admittance probably left him feeling insecure: he cleverly ingratiated himself with the people, and by aid of the shrewd Ahithophel organized a rebellion against his father, which took David unaware and forced him to fly east of the Jordan with a small following, while Absalom gained possession of Jerusalem and the court. With this enormous *de facto* advantage he might easily have maintained his seat; but according to the story, one Hushai, pretending to desert David, ingratiated himself with Absalom, and by cunning and flattery persuaded him to a policy of delay, while Ahithophel urged him to strike quick and hard, the obviously sensible course. David with this breathing-space collected an army; his veteran captain Joab, gray in victories and blood, routed Absalom's forces in «the wood of Ephraim»; and on report that Absalom had been caught by his long hair in the branches he was riding under, and refusal of the messenger to lay hands on the king's son, Joab himself dispatched him with his spear (about 980 B.C.). David could not have suffered the rebel to live; but the statement that he held a grudge against Joab for killing him, and ordered public mourning for his son, has nothing intrinsically improbable in it. Absalom is represented as a very handsome and charming prince, and the chronicler plainly has much sympathy with him.

Absalom and Achitophel, a satire of Dryden's, published 1681, with a second part next year mainly by Nahum Tate. It was aimed at the efforts of the Whig party to put forward the Duke of Monmouth, Charles II.'s illegitimate son, for the succession against the Duke of York, afterward James II. It is classic literature for the force and fire of its poetry, its intellectual keenness, and its brilliant characterizations of politicians of the «Popish Plot» time under the guise of Scriptural characters: the Earl of Shaftesbury as Achitophel (Ahithophel), Buckingham as Zimri, Slingsby Bethel as Shimei, Halifax as Jotham, etc.; also his poetical contemporaries Shadwell and Settle as Og and Doeg.

Abscess, a local collection of pus in a cavity formed by the breaking down of tissue. See SUPPURATION.

Abschatz, Hans Assmann, äp′-shats, FREIHERR VON, poet: b. Würbitz, 4 Feb. 1646; d. Liegnitz, 22 April 1699. A lyric poet of his day, whose poems were in great part called forth by his indignation at the predatory wars of the French. They are simple and without bombast, and show sincere feeling, pure sentiment, and a sturdy, patriotic mind entirely free from class prejudices. His ‹Poems and Translations› (1704) include a German translation of Guarini's ‹Pastor Fido.› Selections from them were edited by W. Müller in 1824.

Absecon, or **Absecum,** a bay and an inlet on the coast of New Jersey, northeast of Atlantic City.

Absconding, the going clandestinely or secretly out of the jurisdiction of the courts, or lying concealed, in order to avoid their process. A person who has been in a State only transiently or has come into it without any intention of settling therein cannot be treated as an absconding debtor (15 Johns. N. Y. 196), nor can one who openly changes his residence (3 Yerg. Tenn. 414). It is not necessary that the debtor should actually leave the State.

Absenteeism, a term applied to the owners of estates in a country who habitually absent themselves from that country and spend the income of their estates in it in another; in current use, referring almost wholly to the Irish nobility whose fixed residence is outside of Ireland. Much of the poverty and many of the disturbances in Ireland have been charged directly to it, and the Irish people have protested against it since 1380. While an Irish Parliament existed, there seemed hope for its gradual dwindling, careers being open for ambitious men in Ireland; but with its abolition the evil is almost incurable. Hungary suffered heavily from the same cause — its aristocracy looking on their native country's language and life as badges of barbarism, priding themselves on being Germans and living in Vienna — till the great national movement set going by Szechenyi and his companions early in the 19th century. Despite the defense of the system by some economists, and the good theoretical arguments that may be made for it, in practice its economic, social, personal, and political mischiefs are obvious. Not only is the absent landowner and property-owner, collecting his rents by agents, inaccessible to complaints, representations, appeals for help in upbuilding local institutions, etc., and unwilling to acknowledge rackrenting he does not personally see to be such (even a generous and kindly agent dares not be as lenient as he would, in fear of his master); but he should be the leader of his section, the fountain of careers, furnishing it employment, having his own success depend on its prosperity, and the active defender of its interests, and rights, and susceptibilities. The estate of an absentee owner, in fact, is essentially like a colony in the old conception,— a mine to exploit for outsiders who cared nothing for it; but the colonists of a distant province have a collective power much greater than that of the tenants of an absent landlord. Furthermore, it makes social co-operation for general needs almost impossible. The literature on this subject is nearly coincident with that of the Irish question as a whole; and the debates in Hansard's ‹Parliamentary Reports› abound in its discussion.

Ab′sima′rus, a soldier of fortune who raised, against the Byzantine emperor Leontius, an army which proclaimed him emperor, A.D. 698. He slit Leontius' ears and nose and threw him into a convent. He was taken in 705 by Justinian II., who, after having used him as a footstool at the hippodrome, ordered him to be beheaded.

Absinthe, a drink prepared from alcohol, the active principle of *Artemisia absinthium,* and other aromatics, notably the volatile oil of anise. Its frequent and prolonged use leads to a diseased condition known as absinthism that is a product of chronic alcoholism to which the

effects of the volatile oil of *Absinthium* are added. Other volatile oils probably contribute somewhat to the general result. Absinthism, in the main, is characterized by a greater amount of affection of the brain than is simple alcoholism. The action of the volatile oils is to heighten cerebral excitement, and absinthe-mania is a frequent result of this form of intoxication. See WORMWOOD.

Absolute, opposed to relative; means that the thing is considered in itself and without reference to other things.

In Logic.—(1) Absolute or non-connotative, according to Whately, is opposed to attributive or connotative. The former does not take note of an attribute connected with the object, which the latter does. Thus « Rome » and « sky » are absolute terms; but « Rome, the capital of Italy,» and « our sky » are attributive or connotative. (See Whately's ‹ Logic,› bk. ii., ch. v., §§ 1, 2–5.) (2) According to J. S. Mill, it is incorrect to regard non-connotative and absolute as synonymous terms. He considers absolute to mean non-relative, and to be opposed to relative. It implies that the object is to be considered as a whole, without reference to anything of which it is a part, or to any other object distinguished from it. Thus « man » is an absolute term, but « father » is not, for father implies the existence of sons and is therefore relative. (J. S. Mill's ‹ Logic,› bk. i., ch. ii.)

In Grammar, a case absolute is one consisting essentially of a substantive and a participle, which form a clause not agreeing with or governed by any word in the remainder of the sentence. In Greek, the absolute case is the genitive; in Latin, the ablative; in English, it is considered to be the nominative. In Latin, the words *sole stante* in the expression *sole stante terra vertitur* (the earth turns round, the sun standing still — that is, while the sun is standing still) are in the ablative absolute. In English, *thou leading,* in the following familiar quotation —

« I shall not lag behind, nor err
The way, thou leading —» (Milton)

is in the nominative absolute. So also is *I rapt* in the line —

« And, I all rapt in this, ‹Come out,› he said.»
— Tennyson's ‹ Princess,› Prol. 50.

In Law.—(1) Personal rights are divided into absolute and relative — absolute, which pertain to men as individuals; and relative, which are incident to them as members of society, standing in various relations to each other. The three chief rights of an absolute kind are the right of personal security, the right of personal liberty, and the right of private property. (Blackstone's ‹ Commentaries,› bk. i., ch. i.) Similarly there are absolute and relative duties. Public sobriety is a relative duty, while sobriety, even when no human eye is looking on, is an absolute duty. (Ibid.) Property in a man's possession is described under two categories, absolute and qualified property. His chairs, tables, spoons, horses, cows, etc., are his absolute property; while the term « qualified property » is applied to the wild animals on his estate. (2) An absolute decision is one which can at once be enforced. It is opposed to a rule *nisi,* which cannot be acted on until cause be shown, unless, indeed, the opposite party fail to appear. (3) Absolute law: The true and proper law of nature. (4) Absolute warrandice (Scotch conveyancing): A warranting or assuring against all mankind.

In Physics, absolute is opposed to relative. As this relativity may be of many kinds, various shades of meaning arise; thus: —

(1) Absolute or real expansion of a liquid, as opposed to its apparent expansion, the expansion which would arise when the liquid is heated if the vessel containing it did not itself expand.

(2) Absolute gravity is the gravity of a body viewed apart from all modifying influences, as, for instance, of the atmosphere. To ascertain its amount, therefore, the body must be weighed *in vacuo.*

(3) Absolute motion is the change of place on a body produced by the motion so designated, viewed apart from the modifying influence arising from disturbing elements of another kind.

(4) Absolute force of a centre: strength of a center.

In Astronomy, the absolute equation is the aggregate of the optic and eccentric equations.

In Algebra, absolute numbers are those which stand in an equation without having any letters combined with them. Thus, in the equation $2x + 9 = 17$, 9 and 17 are absolute numbers, but 2 is not so.

In Theology, God is often spoken of as absolute, because any relations he has to other beings are unessential to his nature.

In Morals, absolute ethics are those based on a fixed standard, independent of time or society.

In Metaphysics, the absolute is an existence apart from all attributes by which it is known as a phenomenon; but as it cannot be known except by the relation between such attributes and those already known to the mind, knowledge of the absolute, or of ultimate reality, is contradiction in essence, as the means of knowing it necessarily reduce it to a phenomenon. In other words, the absolute must exist apart from all relations, and knowledge itself is relation. It would be possible only to a being whose consciousness and the objects cognized were one and the same — that is, an existence which in itself is the universe both of objects and of mind at once, and those objects phases of its own mind — the Spinozan conception. Absolute space is considered apart from the material bodies in it. Absolute time is time viewed apart from events or any other subjects of mental conception with which it may be associated.

Absolute Zero.— The temperature at which bodies are entirely destitute of heat. For discussion of the principles upon which the determination of the absolute zero is based, see THERMODYNAMICS; ZERO.

Absolute, Sir Anthony, a character in ‹ The Rivals,› a comedy by R. B. Sheridan. He is a hot-headed, fiery-tempered, generous old man, always in a towering passion, even while he commends his own mildness of manner. His son, Captain Absolute, is the hero of the play.

Absolution, in ecclesiastical usage, the freeing from sin or its penalties. In the Catholic Church absolution has two important and distinctive bearings: (1) Absolution from sin; (2) Absolution from censures. The first is defined as the remission of sin, and can only be given

by a duly ordained priest in the Sacrament of Penance, which requires, on the part of the penitent, a sincere confession of all his sins, contrition and a firm purpose of amendment. The basis of the doctrine is the authority of the Church and the commission in John xx. 23. In circumstances, where the conditions of the Sacrament of Penance cannot be fulfilled, as in severe illness when the penitent is too weak to speak, or in instant danger of death, conditional absolution may be given on the ground of the moral conviction of the penitent's virtual desire to comply with all the necessary conditions. The Councils of Florence and of Trent defined the form of words to be used: "I absolve thee from thy sins, etc." In the Greek or Eastern Church the deprecatory form is used: "May Christ absolve thee, etc." Absolution from censures merely removes penalties imposed by the Church. It may be given either in the Sacrament of Penance, or in the external form, that is, in the courts of the Church. It is not necessary for the person to be absolved from censures, to be present or even living. Absolution for the dead is a short prayer imploring eternal rest and the remission of the temporal penalties of sin over a dead body. In the Protestant Churches in general absolution is simply a declarative power of the minister imploring the divine forgiveness. Consult: 'Decrees of Council of Trent'; Denys de St. Marthe, 'Traite de la Confession'; Morinus.

Absorption. In chemistry, absorption is the taking up of a gas by a liquid or by a porous solid; and in natural philosophy it is the taking up of rays of light and heat by certain bodies through which they are passing. Absorption of light is the retention of some rays and the reflection of others when they pass into an imperfectly transparent body. If all were absorbed, the body would be black; if none, it would be white; but when some rays are absorbed, and others reflected, the body is then of one of the bright and lively colors.

In chemistry the co-efficient of absorption of a gas is the volume of the gas reduced to 0° Cent. and 760 m. m. pressure, which is absorbed by the unit of volume of any liquid.

Absorption of heat is the retention and consequent disappearance of rays of heat in passing into or through a body colder than themselves.

Absorption of the earth is a term used by Kircher and others for the subsidence of tracts of land produced by earthquakes.

In physiology it is the taking in by the specialized cells of the products of digestion. See GASES, GENERAL PROPERTIES OF; LIGHT; OCCLUSION; SPECTRUM.

Abstract of Title, a synopsis, or brief statement, of the evidences of ownership of real estate. An abstract should set forth briefly but clearly every deed, will, or other instrument, together with every fact relating in any way to the title, in order to enable the party in interest to form an opinion as to the exact state of the title. The vendor of land, in England, usually furnishes the purchaser with an abstract of title. The vendor is not compelled to furnish an abstract of title in the United States. He usually undertakes to give only a marketable title. Plans and sketches of the premises are generally inserted in abstracts of title.

Abstraction. In psychology, that process of the mind by which the attention is concentrated upon one element of a complex idea to the exclusion of the other elements. In thought one object may be taken out — abstracted from — a group of objects, or one element separated from the group of elements that go to make up the object presented to our senses. Another form of abstraction is that process of the mind by which general notions or concepts are formed. The process of abstraction for the child begins in his noticing differences in familiar objects. Within certain groups some differences are found to be unimportant. These qualities which are found to be of less importance are then abstracted or removed from the complex idea for which the word denoting this group of objects stands. As this process develops it becomes deliberate, and the attention may be directed upon resemblances instead of differences. At this stage the grouping of objects according to likenesses results in classification. Consult: G. T. Ladd, 'Psychology, Descriptive and Explanatory,' New York, 1894; W. James, 'Principles of Psychology,' New York 1890; or any work on general psychology.

Absyrtus. See ARGONAUTS.

Abt, Franz, äpt, a German song-writer and conductor: b. Wiesbaden, 22 Dec. 1819; d. 31 March 1885. He studied theology at Leipsic, but abandoned it for music at Mendelssohn's instance. In 1841 he became kapellmeister at the court theatre at Bernburg; shortly afterward relinquishing the post for a similar one in Zürich, where he remained till 1852. He was then called to Brunswick as chief conductor of the orchestra in the royal theatre, and made court kapellmeister in 1855. In 1872 he came to the United States at the invitation of a number of choral societies, and was very favorably received; he conducted at the famous Peace Jubilee in Boston in that year. In 1881 he retired to Wiesbaden on a pension. Many of his songs (for example, 'When the Swallows Homeward Fly,' 'Good Night, Thou Child of My Heart,' 'O Ye Tears,' etc.), have endeared themselves to the heart of the people all over the world.

Abydos, Greece, town and castle of Asia Minor, on the Hellespont or Straits of Gallipoli, nearly opposite Sestus. It is famous as being the point from which Xerxes made his celebrated crossing of the Hellespont on the bridge of boats; and, also, as being the scene of the loves of Hero (q.v.) and Leander (see MUSÆUS). Byron adopts the name in his 'Bride of Abydos' (1813), characterizing it as a clime where "All, save the spirit of man is divine." It is thought originally to have been a Thracian town, but it subsequently became a Milesian colony. In 411 B.C. Abydos revolted from Athens and went over to Dercyllidas the Spartan. Subsequently the city was captured by Philip II. of Macedonia, but in 196 B.C. it was declared free by the Romans. Another Abydos was situated in Egypt on the upper Nile, and in the Thebaid was second in importance only to Thebes. It has become famous in modern times because of important ruins found there, the Palace of Memnon and the tomb of Osiris being among them. Here also was found the Tablet of Abydos.

Abyssinia, or **Habesh**, hä'-besh, an ancient kingdom of E. Africa, now under a monarch who claims the title of emperor. Pop. some 3,500,000. Abyssinia may be said to extend between lat. 8° and 16° N., and lon. 35° and 41° E., having Nubia N. and W., the Sudan W., the Red Sea littoral (Erythræa, Danakil country, etc.) E., and to the S. the Galla country. The area within these limits is about 160,000 square miles, but the present ruler claims a much more extensive territory; and latterly Abyssinia has come to be surrounded by regions belonging to or influenced more or less by Italy, France, and Great Britain. The principal divisions of Abyssinia are the provinces or kingdoms of Shoa in the south (including Efat), the strongest and best organized state in Abyssinia,— capital, Ankobar, of some 7,000 people, 8,000 feet above sea-level, with a salubrious climate; Amhara in the centre (including Gojam), capital, Gondar, situated on the Gondar plateau, 7,500 feet above the sea; and Tigré in the north, chief places, Antalo, and Adua or Adowa, with Axum near the latter, none of them much over 2,000 population. Adis Abeba in Shoa is the present residence of the ruler, transferred from Adowa after the Italian war, and has grown within two or three years from a small village to a city of some 80,000 inhabitants.

Topography.— The more marked physical features of the country may be described generally as consisting of a vast series of tablelands of various and often of great elevations, and of numerous ranges of high and rugged mountains, some of them of very singular forms, dispersed over the surface in apparently the wildest confusion. From these mountains flow inexhaustible supplies of water, which, pouring down by the deep and tremendous ravines that everywhere intersect them, impart an extraordinary fertility to the plains and valleys below.

The loftiest and most remarkable mountain summits occur in the centre of the northern part of the kingdom, immediately west of the Tacazzé River. Among the highest of these (so far as known) is Ras Dashan, calculated at 15,167 feet and capped with perpetual snow. Abba Yared and Buahit are estimated even higher. Along the eastern side of the country extends a mountain range or escarpment forming a natural rampart, with a mean elevation of 7,000 or 8,000 feet for some 600 miles. No volcanoes are known to exist at present, but almost everywhere are numerous evidences of past volcanic action. Perhaps the principal river of Abyssinia is the Tacazzé, rising in the mountains of Lasta, about lat. 12° N.; lon. 39° 20′ E. It runs north and then west, and after leaving the bounds of Abyssinia takes the name of Atbara, and finally joins the Nile. The chief of the other rivers — if not indeed the chief of all — is the Abay or Abai in the southwest, which after flowing through Lake Dembea, runs south and then northwest, and later becomes the Bahr-el-Azrek or Blue Nile, of which it is in fact the upper portion.

Fauna.— The domestic animals consist of horses, cattle, sheep, goats, camels, mules, and asses. Mules, camels, and asses are the usual beasts of burden, the horses being generally reserved for war and the chase. Vast herds of oxen are met with throughout the country. The wild animals are the lion (rare), elephant, hippopotamus, rhinoceros, crocodile, buffalo, hyena, leopard, boar, antelope, zebra, quagga, giraffe, gazelle, and civet. The hippopotamus abounds in Lake Tsana, and great numbers are killed annually for their flesh and hides. The rhinoceros, like the elephant, inhabits the low, moist grounds, and is numerous in certain districts. Crocodiles are found in various rivers, but the largest and most dreaded are those that inhabit the Tacazzé. The buffalo, a comparatively harmless animal in other countries, is here extremely ferocious. Serpents are numerous, among them being the boa, which often attains a length of 20 feet. Bees are numerous, honey being a general article of food; locusts often lay the land waste, and the tsetse fly is destructive to cattle during the rainy season.

Productions.— The chief mineral products of Abyssinia are iron, sulphur, coal, and salt. Coal-beds extend along the whole of the eastern frontier of Shoa, but as a combustible coal is scarcely known in the country. Salt is obtained in various places, especially from a plain on the southeastern border of Tigré. Gold is obtained from alluvial deposits, but not in great quantity. In some parts of the country iron is abundant and is manufactured into implements. A few hot mineral springs are known and used.

Climate.— The climate of Abyssinia is as various as its surface. In the valleys it is delightful, but on the mountains often cold. The rains begin in June and continue till September (over a considerable portion of the country at least), during which period they are often so violent as to put a stop to agricultural labor and all other outdoor operations. The finest months of the year are December and January.

Commerce.— The foreign trade is chiefly carried on through Massowa, Berbera, Zeila, Jibutil, Obok, and other non-Abyssinian ports on the Red Sea and Gulf of Aden; but the external traffic has never been of great importance, as the nature of the country is adverse to an extensive trade, and there are relatively few commodities suited for export; moreover, till recently the natives dared not trust their treasures out of their secret hoards, and the royal court was the chief buyer. Menelek's firm administration, however, with its better security for life and property, has recently been extending Abyssinian trade considerably, the United States and Great Britain being the chief beneficiaries, France and Germany ranking next. The imports of 1899–1900 into Adis Abeba, the capital, and Harrar, near British Somaliland, the chief trade centres, were about $3,500,000. The chief exports are coffee to Arabia, gold to India, wool, skins, ivory and rhinoceros horns, honey, wax, gums, civet, and ostrich feathers; the chief imports, cotton goods, in which American fabrics take the lead, silks, firearms and needles, bottles, tobacco, pepper, and antimony for cosmetics. Trade is greatly hampered by the primitive methods of communication, which is carried on by mules and pack-horses; the distance traversed being not above six to eight miles a day at best. Now, however, French capital is building — for politics, but none the less to the profit of trade — a railroad 184 m. long from Jibutil on the Gulf of Aden to Harrar, south-southwest, to be eventually extended to Adis Abeba; and the Italians are building one.

Arabs had invaded the country and obtained a footing in Adel, though they were unable to extend their conquests farther. For several centuries afterward the kingdom continued in a distracted state, now torn by internal commotions, and now invaded by external enemies (Mohammedans and Gallas). To protect himself from the last the emperor of Abyssinia, about the middle of the 16th century, applied for assistance to the king of Portugal, promising at the same time implicit submission to the Pope. The solicited aid was sent, and the empire saved. The Roman Catholic priests, having now ingratiated themselves with the emperor and his family, endeavored to induce them to renounce the tenets and rites of the Coptic Church and adopt those of Rome. This attempt, however, was resisted by the ecclesiastics and the people, and finally ended, after a long struggle, in the expulsion of the Roman Catholic priests about 1630. The kingdom gradually fell into a state of anarchy, which about the middle of the 18th century was complete. The Negus received no obedience from the provincial governors, who besides were at feud with one another and severally assumed the royal title.

Abyssinia thus became divided into a number of petty independent states. A remarkable, but, as it proved, quite futile attempt to resuscitate the unity and power of the ancient kingdom was begun about the middle of the 19th century by King Theodore, who aimed at the restoration of the ancient kingdom of Ethiopia, with himself for its sovereign. He introduced European artisans, and went to work wisely in many ways, but his cruelty and tyranny counteracted his politic measures. In consequence of a slight, real or fancied, which he had received at the hands of the British government, he threw Consul Cameron and a number of other British subjects into prison in 1863, and refused to give them up. To effect their release an army of nearly 12,000 men under Sir Robert Napier was dispatched from Bombay in 1867; it landed at Zulla on the Gulf of Aden in November, and marching up the country came within sight of Magdala, Theodore's capital, in the beginning of April 1868. Defeated in a battle, Theodore delivered up the captives and shut himself up in Magdala, which was taken by storm 13 April. Theodore was found among the slain, the general opinion being that he had fallen by his own hand.

After the withdrawal of the English, fighting immediately began among the chiefs of the different provinces; the three most powerful, Kasa, Gobasie, and Menelek, struggling for the supremacy. This state of matters continued for some time; but at last the country was divided between Kasa, who secured the northern and larger portion and assumed the name of Johannes, and Menelek, who gained possession of Shoa. Latterly Johannes made himself supreme ruler, with the title of emperor, or king of kings (Negus Negusti). Taking advantage of the troubles in Abyssinia the Egyptians annexed Massowa and adjoining territory on the Red Sea, and hostilities were repeatedly carried on between them and Johannes. In 1885 the Egyptian forces were withdrawn, and Italy, with the consent of Great Britain, declared a protectorate over Massowa and the strip of territory along the coast of the Red Sea. In the following year the Italians pushed inward to Saati, a few miles west of Massowa, an action which led to war with Johannes. An Abyssinian force was sent in 1887 to recover Saati; but though a small Italian force was cut to pieces at Dogali the Italians maintained their position.

On the death of Johannes in 1889, while fighting against the Mahdists, Menelek, who had concluded an alliance with Italy, raised himself to the imperial throne. The result of this was the strengthening of the Italian hold on the country. The Italians regarded their treaty with Menelek as giving them a protectorate over Abyssinia, and by 1892 the whole of Ethiopia was generally recognized as within the Italian sphere. Proceeding to extend and strengthen their position, the Italians in 1889 occupied Keren, capital of the Bogos country, situated 60 miles west of Massowa, and also fortified Asmara, southwest of Massowa. Adowa, the capital of Tigré, and the centre of opposition to Menelek, was occupied in the following year. The Mahdists were also defeated, and Kassala in the Sudan was occupied by the Italians. Menelek, however, later repudiated the Italian protectorate, broke with his former allies, and in 1896 his troops inflicted on them such a defeat as gave a death-blow to their claim of a protectorate over all Abyssinia. The treaty concluded in that year between Menelek and the Italians practically abrogated the treaty of seven years before, but left Italy in possession of a strip along the Red Sea coast from the French colony of Obok on the south to Ras Kasar on the north, known officially as Eritrea (Erythræa). A British mission in 1897 was favorably received by the emperor, and the boundaries between Abyssinia and the British Somali protectorate were arranged. In 1903, Robert P. Skinner of the United States Department of State negotiated a commercial treaty with Emperor Menelik. The American commissioner was impressed by the commercial possibilities of Abyssinia. He found the country admirably suited to cotton growing. Minerals are abundant, and the deposits are practically untouched.

Abyssinian Church, The. Founded by Frumentius, the first bishop of Ethiopia, about 330 A.D. About 470 a great company of monks established itself in the country, completely changing the doctrines and affairs of the Church, but was a few years later expelled. From 1528 to 1540, the country was overrun by Mohammedans, followed at the end of the 15th century by the Portuguese missions, which remained till 1633, when the Abyssinians resumed allegiance to the Church at Alexandria. The metropolitan or head of the Church is appointed by the patriarch of Alexandria, and is always a foreigner. The Abyssinians are monophysites, generally agreeing with the Copts in ritual and practice. The fasts are long and rigid; confession and absolution are strictly enforced and the Sabbath and the Levirate law are generally observed. Idolatry, purgatory, extreme unction, crucifixes, etc., are prohibited. The priests must marry, but only once. The liturgy is celebrated on the ark in the king's palace at Christmas, Epiphany, Easter, and the Feast of the Cross. The Scriptures are read in Geez, the literary language, which is used for all services.

Acacia (Gr. *akē*, spine, from their spiny stalks), a genus of plants, order *Leguminosæ*, sub-order *Mimoseæ*. They are trees or shrubs with compound pinnate leaves and small leaflets,— in some species wholly or partially undeveloped, when the petiole or leaf-stalk expands into a blade resembling a leaf, hence called phyllodium. It yields gum arabic, gum senegal, and other gums; some have astringent barks and pods, used in tanning. The Australian species contains considerable tannin, and hence is exported to a large extent. The Indian tree yields an astringent called catechu.

Acacius, a-kā'-shius, bishop of Cæsarea 340-365 A.D. He founded a curious Christian sect called Acacians, and that may be termed *homoiothelites*, as they held that the Son was like the Father in will, but not of the same or similar substance; thus differing from the Arians. He induced a synod at Constantinople in 359 to accept the doctrine, whereon St. Jerome said that «the world groaned and wondered to find itself Arian.» It was finally condemned, however, and he was banished.

Acacius, St., bishop of Amida in Mesopotamia, early in the 5th century. He sold the church plate to redeem 7,000 starving Persian slaves. Vararanes (Bahram), the king, is said to have been so affected by this noble action that he sought an interview with the bishop, which resulted in a peace between that prince and Theodosius II., A.D. 422, and a hundred years' peace was sworn between Rome and Persia.

Academics, a name given to a series of philosophers who taught in the Athenian Academy, the scene of Plato's discourses. They are commonly divided into three sects: (1) The Old Academy, of which Plato was the immediate founder, was represented successively by Speusippus, Xenocrates, and Polemon. (2) To them succeeded Arcesilaus, the founder of the Middle Academy. Under his hands the Platonic method assumed an almost exclusively polemical character. His main object was to refute the Stoics, who maintained a doctrine of perception identical with that promulgated by Dr. Reid in the 18th century. Socrates is said to have professed that all he knew was that he knew nothing. Arcesilaus denied that he knew even this. Wisdom he made to consist in absolute suspension of assent; virtue, in the probable estimate of consequences. He was succeeded by Lacydes, Telecles, Evander, and Hegesinus. (3) The New Academy claims Carneades as its founder. His system is a species of mitigated scepticism. He was succeeded by his disciple, Clitomachus. Charmides, the third and last of the new academicians, appears to have been little more than a teacher of rhetoric.

Académie des Beaux Arts, ak-ad-ā-mē dā bō zar. See ACADEMY OF FINE ARTS.

Academy, the gymnasium in the suburbs of Athens in which Plato taught, and so called after a mythical hero Academus, to whom it was said to have originally belonged. Anciently there were two public academies: one at Rome, founded by Adrian, in which all the sciences were taught, but especially jurisprudence; the other at Berytus, in Phœnicia, in which jurists were principally educated. Academy is the name also of a society or an association of artists, linked together for the promotion of art, or of scientific men similarly united for the advancement of science, or of persons united for any more or less analogous object. Thus the French possess the celebrated Academy or Institute. (See ACADEMY, FRENCH.) The use of the word "academy," different from the ancient one, is believed to have arisen first in Italy at the revival of letters in the 15th century. The nearest approach to these institutions in America is the Smithsonian Institution in Washington.

Academy, French, an institution founded in 1635 by Cardinal Richelieu for the purpose of refining the French language and style. It became in time the most influential of all literary societies in Europe. Together with the Academy of Inscriptions and Belles Lettres, the Academy of Moral and Political Sciences, and the Academy of Sciences, it composes the National Institute of France. It published in 1694 the first edition of a dictionary. It has exercised a conservative influence on French literature and favors taste rather than originality. It consists of 40 members, besides a director, a chancellor, and a secretary. In 1793 it was suppressed by the Convention, but was re-established in 1816. The French Academy originated in a simple meeting of friends who met at the house of Conrart, one of their number. These reunions were held informally for many years. At last they attracted the attention of Richelieu, who in 1634 proposed to form an Academy, and from the 13th of March in that year a record was kept of their transactions and a director or chancellor and a perpetual secretary were appointed. The Academy was definitely formed by letters patent of Louis XIII. in January 1635; they were registered by Parliament 10 July 1637. At first the number was 30. The perpetual secretaries since the foundation have numbered 19, and the incumbent receives a salary of 6,000 francs and lodgings at the Institute. Ordinary members receive 1,500 francs a year. In 1880 the discussion of the qualifications of candidates which had been in vogue for more than 10 years was abolished, but restored in 1896. In 1671 the sessions of the Academy became public. The library of the Institute was founded by Louis XIV., who presented to it 660 volumes. The members of the Academy, often spoken of as «the forty immortals,» were, in 1901, with the dates of their election: Ernest W. G. B. Legouvé, 1855; Duc de Broglie, 1862; Emile Ollivier, 1870; Alfred J. F. Mézières, 1874; Gaston Boissier, 1876; Victorien Sardou, 1877; Duc d' Audiffret-Pasquier, 1878; Aimé J. E. Rousse, 1880; René F. A. Sully-Prudhomme, 1881; Adolph L. A. Perraud, 1882; Édouard J. H. Pailleron, 1882; François E. J. Coppée, 1884; Joseph L. F. Bertrand, 1884; Ludovic Halévy, 1884; Vallery C. O. Gréard, 1886; Comte d' Haussonville, 1886; Jules A. A. Claretie, 1888; Vicomte de Vogüé, 1888; Charles L de Freycinet, 1890; Julien Viaud, 1891; Ernest Lavisse, 1892; Vicomte de Bornier, 1893; Paul L. Thureau-Dangin, 1893; Ferdinand Brunetière, 1893; Albert Sorel, 1894; José M. de Heredia, 1894; Paul Bourget, 1894; Henri Houssaye, 1894; Jules Lemaitre, 1895; Anatole France, 1896; Marquis de Beauregard, 1896;

Gaston Paris, 1896; André Theuriet, 1896; Comte Vandal, 1896; Comte de Mun, 1897; Gabriel Hanotaux, 1897; Claude J. B. Guillaume, 1898; Henri L. E. Lavedan, 1899; Paul Deschanel, 1899; Marquis de Vogue and Edmond Rostand, 1901.

Academy, The Royal Spanish, an institution established at Madrid in 1714 for the same purposes as the French Academy. The number of members is limited to 24.

Academy of Arts, The Royal, a British institution for the encouragement of painting, sculpture, and designing; founded in 1768 by George III., with Sir Joshua Reynolds as president. It is composed of a president (P.R.A.), 40 academicians (R.A.), and 20 associates (A.R.A.), which include professors of painting, architecture, anatomy, and perspective. It holds an annual exhibition, open to all artists, at Burlington House, London, of paintings, sculpture, and designs which reach a certain standard of merit.

Academy of Design, National, an American institution in New York city, founded in 1826, conducting schools in various branches of the fine arts, and holding semi-annual exhibitions at which prizes are awarded. The membership consists of academicians, who are the corporate body and use the title N.A. (National Academician), and the associates, who use the title A.N.A. (Associate of the National Academy), all, of necessity, artists. Laymen may become fellows of the academy on payment of graded fees.

Academy of Fine Arts, The, a French institution, originally founded in 1648 at Paris under the name of the Academy of Painting and Sculpture. In 1795 it was joined to the Academy of Architecture, and has borne its present name since 1819. It publishes memoirs, proceedings, and a dictionary of the fine arts. It has 41 members, besides corresponding members, etc.

Academy of France at Rome, an institution for the advanced study of the fine arts in Rome, Italy, founded by Colbert in 1666, during the reign of Louis XIV. It was at first established in the ruined villa Mancini on the Corso, and in 1803 at the villa Medicis. The young artists, painters, sculptors, architects, engravers, and musicians who secure the annual prizes of the Academy of Fine Arts in Paris spend four years there, with an annual pension of 3,500 francs and traveling expenses.

Academy of Inscriptions and Belles Lettres, an institution founded at Paris by Colbert in 1663, under the name of Petite Académie. It was composed originally of four members, chosen by the ministry to belong to the Académie Française. The first members, Chapelain, Charpentier, the Abbé de Bourzers, and the Abbé Cassagne, met in a salon of the Louvre or in Colbert's library, and devoted themselves to composing the inscriptions for the monuments erected by Louis XIV. and the medals struck in his honor; hence their popular name. They undertook a medallic history of the reign of the king. In 1701 the Academy assumed its definitive form; 40 academicians were named. In 1803 the Academy was reconstituted and became the third class of the Institute. Comparative philology, Oriental, Greek, and Roman antiquities and epigraphy, have received the attention of the Academy, which has published a series of invaluable records and works.

Academy of Medicine, a French institution, founded in Paris in 1820 for the purpose of keeping the government informed on all subjects appertaining to the public health. It has sections of medicine, surgery, and pharmacy, and its publications are highly prized by sanitarians.

Academy of Moral and Political Science, founded at Paris in 1795, became the second class of the Institute. It was suppressed by Napoleon in 1803, but was re-established by Louis Philippe in 1832, and forms the fifth class of the Institute. It is composed of 30 members, divided into 5 sections, with 5 free academicians, 5 foreign associates, and 30 corresponding members.

Academy of Natural Sciences of Philadelphia, an institution founded in 1812. It has one of the best natural-history collections in this country — especially rich in stuffed birds — and a valuable scientific library. It has published 'Journals' since 1817, and 'Proceedings' since 1841.

Academy of Political and Social Science, American, an institution organized at Philadelphia in 1889 and incorporated in 1891. It has a large number of members and publishes bi-monthly 'Annals.'

Academy of Sciences, an institution founded at Paris in 1666 by Colbert, and approved by Louis XIV. in 1699. It published about 130 volumes of memoirs from 1666 to 1793, when it was suppressed. It was re-established in 1816. It has now 66 members in 11 sections, with two perpetual secretaries and 100 corresponding members.

Academy of Sciences, The Imperial, a Russian institution, founded in St. Petersburg by Catherine I. in 1725, and largely endowed by Catherine II. It has 15 professors, a president and director, a fine library containing 300,000 volumes and many manuscripts, and a museum very rich in curiosities and objects of natural history. It has published 'Transactions' since 1728, and at present publishes two volumes annually, called 'Acta Academiæ,' including many memoirs on the higher mathematics and the astronomical observations at Pulkowa.

Academy of Sciences, The National, an American institution, founded in 1863, consisting of 100 members, elected from among the most distinguished scientific men of the United States; analogous to the Royal Society of London.

Academy of Sciences, The Royal, a Danish institution in Copenhagen, established by the king of Denmark in 1743. It has published transactions ('Skrifter') since its foundation, and memoirs ('Afhandlinger') since 1823.

Academy of Sciences, The Royal, a German institution in Berlin, founded by Frederick I. in 1700; had Leibnitz as its first director, and held its first meetings in 1711. It is divided into four sections, devoted to mathematics, physics, philosophy, and history. It publishes memoirs and monthly reports.

Academy of Sciences, The Royal, a Swedish institution, known also as the Royal Swedish Academy, founded in Stockholm as a private society in 1739; incorporated under its second name in 1741; issues annual volumes of 'Transactions,' which were at first published quarterly.

Academy of Sciences and Arts, American, an academy established in Boston in 1780 by the Council and House of Representatives of Massachusetts; the successor of an institution founded by Franklin. It has published monthly 'Proceedings' since 1846, and annual 'Memoirs' since 1785.

Acadia (Micmac, «plenty»). See NOVA SCOTIA.

Acadialite, a name given to chabazite (q.v.) from Nova Scotia (Acadia). Its color is usually salmon to flesh-red.

Acajutla, äk-a-hoot'la, Salvador, Central America: its second port in importance,— next to La Libertad, the port of San Salvador,— 10 m. south of Sonsonati, and the seat of a consular agent.

Acanthite, a mineral found chiefly in the silver mines of Bohemia and Saxony. It is a silver sulphide, Ag_2S, identical with argentite (q.v.) in composition, chemical and physical properties. but differs in form, its crystals being orthorhombic, their habit being prismatic and usually elongated. Krenner argues, however, and with considerable force, that acanthite is but a distorted form of argentite.

Acan'thus, the typical genus of the order *Acanthaceæ,* or acanthads, a natural order of monopetalous exogens, consisting of herbaceous plants or shrubs, found chiefly in the tropics, where they often form a large part of the weedy herbage. *Acanthus* is a native of many parts of southern Europe. The family is represented in America by a few wild-growing species; but they are best known as tender garden plants. The best-known species of the genuine acanths (or brancursines, as they were formerly called by a euphemism for the still older «bear's-breech»), are *A. mollis* and *A. spinosus.* The former has a stem about two feet high, surrounded in its lower half with large, soft, shining, hairy, and deeply indented leaves, and covered from the middle to the top with large white flowers tinged with yellow.

In Architecture.— The leaves of either *A. mollis* or *A. spinosus,* conventionalized and used for decoration. The latter only were used by the Greeks in the Corinthian capital, of which they were the characteristic, or in acroteria (see ACROTERION), and the leaves were three-lobed, straight, and pointed. The Etruscan and early Roman forms were of split curling leaves; the later Roman of the Greek trilobate form but using the *A. mollis* with its ampler foliage, and combining it with other leafage — olive, laurel, parsley, etc.— to make a luxuriant decoration of architectural features. The acanthus was also used in decorating furniture, table-ware, vases, embroideries, etc., and in frescoes. It was inherited by the Byzantine and Romanesque artists, and persisted till the Renaissance, when in some parts the Gothic displaced it.

Acaroid Resin, or **Gum,** a resin which exudes so abundantly from the grass-trees (*Xanthorrhœa*) of Australia as to cover the base of the leaves and the underground portions of the plants, and is also obtained by crushing and sifting or washing, as much as 50 or 60 pounds being obtained from one plant. Two kinds, red and yellow, are generally distinguished, and are used in varnishes as well as for several other purposes.

Acarus, a genus of insects of the tribe *Acaridæ,* order *Arachnida.* They are oviparous, have eight legs, two eyes, and two jointed tentacula, and are very prolific. All the species are extremely minute, or even microscopic, as the cheese-mite (*Acarus domesticus*), and many of them parasitic; of the latter, the itch-insect (*Sarcoptes scabici*) is a remarkable example. It is a microscopic animal found under the human skin in the pustules of a well-known cutaneous disease. Many others infect the skin of different animals, such as dogs, hogs, and cattle, and sometimes in considerable numbers. In some instances they damage cow-hides. (See MITES.) *Acarus folliculorum* is a microscopic parasite of the hair follicles of the skin. It is the lowest form of mite, and is known also as *Demodex folliculorum.* See BLACKHEAD.

Acceleration, the rate of change of the velocity of a body. If the velocity of the body is constant, its acceleration is said to be zero. If the velocity increases uniformly, so that at the end of every second it is greater than it was at the end of a preceding second by a constant amount, the acceleration is said to be uniform, and the motion is said to be uniformly accelerated. If the velocity is decreasing, the acceleration is said to be negative. A body falling freely under the influence of gravity affords the most familiar example of uniform (or constant) acceleration. When the body falls in air or any other medium, the phenomena are complicated by the resistance of the medium; but when it falls in a vacuum its velocity increases every second by the same constant amount. Thus if the body starts from rest, it will have a velocity of 32.2 feet per second at the end of the first second, 64.4 feet per second at the end of the second second, 96.6 feet per second at the end of the third second, and so on. The acceleration produced by gravity is therefore said to be 32.2 feet per second per second; but this varies somewhat with the latitude and the height above the sea. (See FORCE OF GRAVITY.) The acceleration experienced under given circumstances is proportional to the force acting upon the body in the direction in which its motion is accelerated. Thus if the foregoing experiment with a falling body were tried upon some other planet, and we found that the velocity of the falling body was increased by 322.0 feet per second every second (instead of 32.2 feet), we should know that the force of gravitation at the surface of that planet is precisely ten times as great as it is upon the surface of the earth. In physics and theoretical mechanics a force is always measured by the acceleration it produces when exerted upon a unit mass. For a further account of the relation between force, mass, and acceleration, also see FORCE.

Accent, the stress or emphasis given by the voice to a certain syllable or syllables of a word, or to certain notes in a bar of music; also, the peculiar intonation of one spoken language when compared with another; further, marks used in printing or writing to show the

position of the stress. In a dissyllable there is but one accent, as a-back', but in a polysyllable there may be more than one. One of these, however, is always greater than the rest and is called the primary accent; the others are called secondary.

Two wholly distinct classes of accent are found in Aryan languages, the musical and the expiratory; the former, which is that of some Semitic tongues also, being that of Greek and Sanskrit, the latter that of Latin and Teutonic. Some languages, as French, have no accent, the stress on all syllables being the same, but even here the stopping of the voice gives the final syllable a slight tilt upwards, with the effect of an accent on that syllable. Accent may be free, as in Greek or old Teutonic,— that is, its position in a word may shift in accordance with the nature of the syllables or of the words which follow,— or fixed, as in later Teutonic and English: perhaps the only remnant of the free accent in English is the word «cannot,» which, though often spelled as two words, is really a compound word with an accent shifting according to emotion. By a change of stress we often indicate the change of an adjective or a noun into a verb, as fre'quent (adj.), frequent' (verb); pro'ject (noun), project' (verb).

In compound words the accent is commonly on the first; but when the first element is a prefix, separable or inseparable, it is accented only when the root-word is noun or adjective, the root receiving the accent if it is a verb,— this of course not applying to words borrowed from other languages, for which there is no settled rule, the chance of first usage commonly determining it. The inflections have almost always been left unaccented, and this has aided greatly in the sloughing off of the whole inflectional system in modern languages: even where retained to the eye they are often not pronounced at all, as in French.

There is a certain analogy between accent and emphasis, emphasis doing for whole words or clauses of sentences what accent does for single syllables. One result of this has been to develop duplicate words with different meanings, as *of* and *off, to* and *too, through* and *thorough* (originally pronounced tho-roo'). All modern verse depends on stress-accent (see METRE); while that of classical Greek and Latin, as of some Semitic tongues still, rested on quantity or length of syllables,— a system not easy for those reared on stress to comprehend, much less imitate.

Marks of Accent.— In ancient Greek, accents marked the rise and fall in pitch of the voice, and were three in number, the acute (á), the grave (à), and the circumflex (ā or â). The same marks are now used in French, and the first two in Italian, though they are largely of historical or etymological interest only, and do not always indicate a difference in pronunciation. A mark similar to the acute accent is sometimes used to signify stress in English words, chiefly in poetry; and one like the grave is used to mark as a separate syllable letters otherwise not pronounced so, for example, learnèd, abhorrèd. Marks sometimes called accents are used in mathematics; for example, $a' + b'$ (read a prime plus b prime). In geometry and trigonometry, a circle at the right of a figure indicates degrees, one mark minutes, two marks seconds of a degree, as 13° 4′ 5″. In mensuration and engineering, the mark denotes feet, inches, and lines, as 4′ 6″ 10‴.

In Music.—The greater emphasis or intensity given to certain notes or passages, as distinguished from their length in time and their quality or *timbre*. It is divided into three classes,— grammatical, rhythmical, and rhetorical or æsthetic. The grammatical accent is almost always on the first part of a bar; long measures have usually secondary ones, as have polysyllables in words. Rhythmical accent is the more pronounced character given to certain parts of larger compositions,— phrases, themes, motifs,— to mark off entrances, finales, or climaxes. Rhetorical accent corresponds strictly to the same emphasis in oratory, in accordance with emotion or a desired effect, and is at the will of the performer.

Accentor («singer-together»), a literary name for the American water-thrushes (genus *Siurus*) and the European warblers, of which the British hedge-sparrow (incorrectly named) is best known.

Acceptance, a bill of exchange drawn on one who agrees absolutely or conditionally to pay it, according to the tenor of the document itself. To render it so valid that, if the drawee fails to liquidate it, the drawer may be charged with costs, the promise of the drawer should be in writing under or upon the back of the bill. An acceptance may be made before the bill is drawn, in which case it must be in writing (15 Johns. N. Y. 6). It may be made after it is drawn and before it becomes due, which is the usual course, or after it becomes due (1 H. Blackst. 313), or even after a previous refusal to accept. The proper form for the acceptance of a bill is to write the word «Accepted» across the bill and sign the acceptor's name, but the drawee's name alone is sufficient, or any words of equivalent force to «accepted.» Byles on Bills, 147; 21 Pick. Mass. 307. See BILL.

Access, Right of. The owner of land adjoining a road or public highway is entitled to access to such highway at any point where it comes up to his land. He may also have an action for the removal, by injunction, of any obstruction to such access, as well as an action for damages.

It has been expressly held also that an abutting owner has a property right in the use of the street in front of his land as a means of egress and ingress, and for light and air. 47 N. J. Eq. 421; 106 N. Y. 157.

If a man buys a lot of land from which there is no access to a public highway, upon application to the proper authorities he may obtain an order for the construction of a road or highway leading from his land to a public highway. See also RIGHT OF WAY.

Accession is the right to all which a man's own property produces, and the right to that which is united to it by accession either naturally or artificially (2 Kent, Comm. 360). If a man builds a house upon his own grounds with the materials of another, or, on the contrary, if a man shall have built a house with his own materials upon the ground of another, in either case the house becomes the property of him to whom the land belongs, for every build-

ing is an accession to the ground upon which it stands, and the owner of the land, if liable at all, is only liable to the owner of the materials for the value of them (2 Kent, Comm. 362). The same rule holds where vines, trees, fruits, and vegetables are planted or sown in the ground of another.

Accessory, in law, one who is not the chief actor in an offense or present at its commission, but still is connected with it in some other way. Accessories may become so before the fact or after the fact. Sir Matthew Hale defines an accessory before the fact as one who, being absent at the time of the crime committed, does yet procure, counsel, or command another to commit a crime. If the procurer be present when the evil deed is being done, he is not an accessory, but a principal. An accessory after the fact is one who, knowing a felony to have been committed, receives, relieves, comforts, and assists the felon. In high treason of a pronounced character there are no accessories — all are principals. In petit treason, murder, and felonies, there may be accessories; except only in those offenses which, by judgment of law, are sudden and unpremeditated, as manslaughter and the like, which, therefore, cannot have any accessories before the fact. So, too, in petit larceny and in all crimes under the degree of felony, there are no accessories either before or after the fact; but all persons concerned therein, if guilty at all, are principals. (Blackst. Comm., bk. iv., ch. iii.) Presence and actual participation are necessary to constitute a person an accessory. The mere fact of presence or failure to interfere to prevent the commission of a crime is not, alone, an indictable offense. The person must act in concert with the active party. He must by word or act contribute to the felonious purpose. Presence need not be actual, it may be constructive. A man may commit a crime through the agency of an innocent person, but the agent cannot be convicted. Where an offense is committed within a State by means of an innocent agent, the employer is guilty as a principal, although he did no act in the State where the crime was committed, and at the time of the commission of the offense was in another State. 1 N. Y. 173 (s. c. 45 Am. Dec. 468); 123 Mass. 430.

Accho. See ACRE.

Acciaioli, Renatus, ätch-yī-ō'lē, a Florentine who conquered Athens, Corinth, and part of Bœotia: lived in the beginning of the 15th century. He bequeathed Athens to the Venetians; Corinth to Theodosius Palæologus, who married his eldest daughter; and Bœotia with Thebes to his natural son Anthony, who also got Athens, but this was retaken in 1455 by Mohammed II.

Accident, an unforeseen occurrence, particularly if it be of a calamitous character. This is the most common use of the word.

In logic: (*a*) Whatever does not really constitute an essential part of a person or thing; as the clothes one wears, the saddle on a horse, etc. (*b*) The qualities or attributes of a person or thing, as opposed to the substance. Thus bitterness, hardness, etc., are attributes, and not part of the substance in which they inhere. (*c*) That which may be absent from anything, leaving its essence still unimpaired. Thus a rose might be white without its ceasing to be a rose, because color in the flowers of that genus is not essential to their character.

Accidents, in logic, are of two kinds, separable and inseparable. If walking be the accident of a particular man, it is a separable one, for he would not cease to be that man though he stood still; while, on the contrary, if Spaniard is the accident connected with him, it is an inseparable one, since he never can cease to be, ethnologically considered, what he was born. (Whately's ‹Logic,› bk. ii., ch. v., sec. 4.)

In grammar, a property attached to a word which nevertheless does not enter into its essential definition. Each species of word has its accidents: thus those of the noun substantive are gender, declension, and number. Comparison in an adjective is also an accident.

In law, an event which under the circumstances is unusual and unexpected by the person to whom it happens. It is the happening of an event without the concurrence of the will of the person by whose agency it was caused, or the happening of an event without any human agency. If a house should be burned in consequence of a fire made for the purpose of cooking, or warming the house, this would be an accident of the first kind. If the house should be set on fire by lightning, this would be an accident of the second kind. 1 Fonblanque, Eq. 374, 375 n. The best test of liability for the consequence of an accident turns upon the fact whether the person causing the accident was guilty of negligence or not. If he was guilty of negligence he would be liable unless the person injured was guilty of contributory negligence.

In heraldry, an additional note or mark on a coat of armor, which may be omitted or retained without altering its essential character.

Accident Insurance, a system which indemnifies the insured person for loss of business time resulting from disabling bodily injuries inflicted by external and accidental violence, or in case of death therefrom within a certain time pays the legal heirs a sum stated in the contract. The former is done by a weekly indemnity (graduated according to premium and hazard of occupation) paid in a lump sum on recovery or at the end of a fixed expiration term; or by a stated sum at once in case of irremediable mutilations. It is a system of *limited* health and life insurance, paying the benefits only in case of death or disablement from a specified class of contingencies instead of from any contingency; therefore bounded on the one hand by life insurance and on the other by the benefit societies, but less costly than the one and to larger amounts than the other. These boundaries of limitation are stated in the contracts: varying in detail, they are and must be in essence the same in all, as they reduce to the two classes which accident insurance exists by excluding, those which are not accidental and those which are not violent. These, however, form five individual groups: (1) Disease or bodily infirmity, direct or as indirect cause; (2) effects of one's own will, vice, or recklessness, as suicide, drunkenness, fighting or breaking the law, voluntary exposure to unnecessary danger, etc.; (3) legal sentences; (4) poison; (5) weather, except violent manifestations like stroke of lightning. These, however, are much

less simple in practical application than in theory and in some cases are virtually dead letters by popular prejudice or even legal enactment. The suicide clause has been scarcely enforceable for many years through the refusal of juries to find it as a question of fact; and of late years several States have passed laws invalidating it in any insurance contract. Drunkenness, though not barred by law, is so nearly impossible to make a jury accept that it is practically never entered in plea. The others are of course contestable and perpetually contested. Furthermore, different companies and forms of policy vary in the extent or severity of their exclusions, some waiving important factors in this list; and all of them now, under stress of competition, have added some portions of health and life insurance to the accident contract proper,— giving indemnities and payment of principal sum for loss of time or for death through certain contagious diseases.

The modern system of accident insurance dates only from 1848; but its purposes were fragmentarily embodied in earlier arrangements. The Hanseatic League, the originator of so many good business ideas, seems to have devised this; at least the Sea Laws of Wisby in 1541 mention the insurance of shipmasters by owners against the perils of the sea,— the insurance of their families of course. A mercantile treatise probably of the same century, compiled for the traders of Rouen, in France, states that « other nations » insure men's lives on voyage, « paying certain sums to their heirs or creditors »; possibly it refers to the same Hanse practice. In 1665 England applied a rough form of it to the casualties of warfare: a regular schedule of indemnities to be paid to soldiers in the Netherlands war was compiled, ranging from £62 10*s.* for both eyes or both arms, £50 for both hands, £29 4*s.* for both legs, and £18 15*s.* for both feet, down to £8 7*s.* for one foot, and with graduated amounts between. Later, a year's pay (not much then) for the loss of a limb was the customary gauge. But this was a mere pension system; and none of these had the essential feature of modern insurance, a business contract as matter of bargain and sale, with the insurance proportioned to the payment.

Modern accident insurance originated in England. Its germ, oddly enough, was primarily not personal but property insurance; not against bodily injury so much as loss of goods in railway accidents. The first charter applied for was for the British and Foreign Life and Property Insurance Co., which never organized; and the insurance of human beings was added apparently rather to make up a « blanket charter » than with much idea of profiting by it. But the swift clarification of business ideas on this point, due to the public horror of great railway accidents, — the concentrated volume of destruction in which makes them much more impressive to the imagination than the really far more formidable mass of scattered daily accidents,— is shown by the fact that of ten other similar charters granted in the next three years none of them mention goods in their titles, and most of them show that their business was personal insurance alone. All, however, had « Railway » in their names, and the « ticket » business was long supposed to be the only one feasible. Only 2 of these 11 ever organized, and the pioneer company, the Railway Passengers' Assurance Co.,— opened business 22 March 1849,— for a long time insured only passengers actually in the coaches, and by the terms of the policy (though not enforced) only covered them while moving, excluding even collisions at stations. Its first rival to be chartered (though not to begin business) covered also accidents on platforms, etc. But the real birthday of the modern general accident business is 3 June 1850, when another company adopted the plan of its actuary, Edward Riley, and extended its insurance to cover all violent bodily injuries.

The next field to be opened was among workmen in the manufacturing districts, their great hazards and consequent need of it making it seem that they would welcome it; but their poverty and ignorance overbalanced their requirements, and the experiment was a failure In 1852 Cornelius Walford suggested that the true field lay among the business and professional classes; and although this at first was scouted as fantastic, their individual hazards appearing too slight to found a great business on, it was followed by a brilliant success and the creation of the modern system substantially as it stands. Attempts were occasionally made to frame narrower schemes, as for carriage accidents alone, etc.; but no success has attended these experiments. A basis as broad as consistent with the essential nature of the business has been found the only one practicable.

The business in the United States was founded in 1863 by James G. Batterson, a Hartford builder, on a suggestion afforded by the Railway Passengers' Assurance Co.'s tickets, and after consultation with the officers of that company, who generously put all their experience at his disposal; it proved, however, to be very misleading for American conditions. On his return to Hartford he associated several other Hartford gentlemen with him, and a charter was procured for the Travelers Insurance Co.; but owing to entire popular disbelief in the system no business was done till April 1864, its first premium being one of two cents, paid in jest by a business man to insure himself in going from his house to his office. A storm of railway accidents about that time, however, shocked the public so that the enterprise soon became a brilliant success, though it was nearly ruined by the new companies which swarmed into the field. Five western States in the winter of 1864 chartered nearly 100 insurance companies of all kinds, over a dozen of them accident companies; and in April 1865, 25 of the latter were organizing in the United States. To save multiplication of ticket equipments at railway stations, where several companies sometimes had them on sale at once, the Railway Passengers' Assurance Co. was organized in May 1865, to consolidate all the ticket business under one head, with office in Hartford. In 1878 all the companies but the Travelers having been long dead, that company reunited the business to its own. There are now several strong companies in the United States, which heads the world in the volume of its accident business. None of them transact this branch of business alone: all combine it with employers' liability (q.v.) (indirect accident insurance, by a subrogated blanket liability to an employer instead of to his employees individually), and most of

them variously either with life, steam-boiler, elevator, plate-glass, surety, or other forms of personal guaranty. Owing to certain peculiarities of the business, its statistics are not easy to give; but it certainly protects a million of men and their families, and pays $20,000,000 a year for death and indemnity claims. About one-tenth of the insured are paid claims of some sort. The most hazardous of the large general occupations — excluding special hazards like the manufacture of gunpowder and dynamite — is that of freight brakemen; due not entirely to the inevitable perils of the employment, though they are large, but partly to the reckless bravado bred of familiarity. Next to these in hazard are the employees of rolling-mills. Among the business and professional classes, much the greatest volume of loss is from horse and carriage accidents, which are many times more destructive than railway accidents.

The development of the accident-insurance field should be noted. It may be compared with the origin of banking from note circulation, which afterward became a feature so insignificant as to be neglectible. Similarly, accident insurance arose from a desire to give protection against the results of railway accidents: but the losses from these do not constitute more than five or six per cent of the total losses among recent companies. Another significant fact is the change in the class mainly covered by it. Theoretically, it should find its chief patronage and profit among those hazardously employed: in fact, the larger companies found long ago that a great business can only be done among these under conditions that render it unprofitable, and after carrying it on for many years on the installment plan, have mostly been obliged to abandon it altogether and confine their efforts to the business and professional classes, or to such of the working class as have means to pay yearly premiums in advance. See INSURANCE.

Accipitres (Lat. plural of *Accipiter*, the common hawk), or *Raptores*. An order of birds, comprising the birds of prey,— eagles, hawks, owls, and vultures. See BIRDS OF PREY.

Acclamation («calling to»): properly, expressing any judgment of an assembly or a large part of it by shouting: but in usage restricted entirely to a favorable one. The choice of rulers among most early Aryan tribes or nations was by acclamation: the candidate was presented by a previous understanding — among the Vikings raised on a shield in the presence of the chiefs — and acclaimed by the voices of the assembled multitude. In some cases, as with the Poles even quite late in their history, the agreement was only made when the throng had gathered and there were more than one set of acclaimers, often ending in a pitched battle to decide which party preponderated. In the minor divisions of modern political life, voting by acclamation is usual; a ballot being called for only when the parties are so evenly balanced that the preponderance is dubious, or a small majority has great strength of lungs, or the minority wish to make the majority put their position on record, or simply to have the satisfaction of a proved vote. In ecclesiastical councils the vote by acclamation comes first also, the question being put as «*placet*» or «*non placet*.» In private matters, acclamation has been used from early times as an expression of good feeling or enthusiasm, as in the customary «hurrahs,» «huzzas,» and «tigers,» and the «hear, hear» of political assemblies, and the responsive shouts and groans of religious revivals or prayer-meetings. The applause in theatres, etc., being non-vocal does not etymologically belong to the group, but is usually included as having the same intent. It began with genuine applause, an actor closing the play by some word asking for approval of the company — in the Roman theatre, «*Plaudite*» («applaud ye»), or a poet or orator who recited in public expecting and receiving applause; but the *claque,* in modern French phrase, was very early organized by rich amateurs, who kept bands of paid applauders not only for their own use but to lend to friends. Nero had 5,000 of these, many of them *equites* or knights, to chant his praises at the direction of a professional music-master; they were called Augustiniani. In the modern French theatre the *claque* is on a more modest footing and is paid by the management; the understood reason being (curiously) that it keeps up the spirits of the actors when the audience's coldness might depress them beyond the power to play well, and more rationally that it guides and stimulates the audience itself to genuine applause when it might be simply sluggish and indifferent. In old times applause was shouted at marriages, as «Io Hymen,» «Hymenæe,» «Talassio»; in festal or religious processions; to victorious commanders in triumphs or ovations, as «Io triumphe»: and even, contrary to modern feelings of decorum, in churches, the pulpit orator being cheered at good passages.

Acclimatization, the gradual alteration which fits a plant or animal to a climate differing from that in which the habits of its species or race have been formed. Acclimatization and naturalization are often mistakenly used as synonymous, but naturalization properly means establishment in a new country, and, if the climates of the two countries chance to be the same, acclimatization is not implied. In the consideration of marine animals and plants acclimatization takes on a slightly different meaning, since aquatic life is more affected by the various conditions of the surrounding water than by climate.

In Plants.— Many examples of acclimatization are furnished by cultivated plants, among which the most noteworthy are perhaps the cereals. The original species of most of these has not been discovered, but in most cases it is supposed to have lived in sub-tropical or warm temperate regions. Some of these cereals now thrive far better or are more productive in cold, northern climates than in warm regions. But in such cases an important influence may to a greater or less extent obliterate or emphasize the apparent period of growth, the productiveness, etc. This is the daily duration of sunlight. During the growing period the sunlight lasts longer as the pole is approached, so that the shorter season is more than compensated for by the increased hours of sunlight. It has been found by experiment that certain varieties of corn brought from the southern States to the northern attained their customary height, but generally failed to ripen seed. The progeny of

such plants as did mature seed gradually assumed the characteristics of northern varieties; they reduced their height and shortened the time necessary to attain maturity. In a few years they resembled other northern varieties in these two respects. The reverse of this case has also been proved; northern varieties taken to the South at first reached the height and attained maturity in the time natural to them in the North, but gradually assumed the characteristics of southern varieties — increased height and greater number of days to reach maturity. But even considering the frequent preponderance of this influence and remembering that the production of seed is usually in opposition to marked development of vegetative parts, there is no doubt that plants, in becoming acclimatized, are compelled to adjust themselves to many other less prominent influences, such as humidity, temperature, light, and wind. The peach is supposed to have come from China by way of Persia, and since early historical times has gradually been fitting itself to more and more northern conditions. It is now found to be a profitable crop in Michigan and New York, which are several degrees farther north than its supposed place of origin. The influence of climate upon cultivated plants is recognized by progressive agriculturists and horticulturists, and each prefers seed grown in a more northerly locality than his own. The effects of the new environment, however, soon become evident, and new importations must be made. Seeds grown at high altitudes exhibit the same characteristics as those produced in high latitudes; that is, they are hardier and require a shorter period to reach maturity than those grown in low altitudes or low latitudes.

Among naturally acclimatized plants are many remarkable phenomena. Deciduous plants taken from cool climates to tropical conditions hold their leaves for a much longer period than where they are indigenous, or may even become evergreen like their new associates. Plants imported from warm regions to cooler may lose the power to ripen seeds, but this defect may be compensated by the development of vegetative reproductive powers. The reverse case is also true. Southern plants may fail to ripen wood completely, and winter killing may result. In cultivated plants, however, this phenomenon, which is often observed in the peach, may be due to improper methods of cultivation resulting in abnormal wood-development.

In Animals.—The capacity for acclimatization is possessed in very different degrees by different animals, even by different individuals of the same species, and depends much upon general hardihood. Exactly what changes take place during acclimatization is not known; sometimes the very specific gravity of the animal is altered, as when fresh-water fishes become adapted to the denser water of the ocean; similarly, the normal temperature of the individual may gradually become altered, as in the case of fishes native to cool water, which chance to work up-stream into hot springs and live there at a temperature which would kill normal individuals of the same species. The animals which are most wide-spread over the earth are those which have the greatest adaptability to new climates and new conditions of environment, and the best examples of this adaptability are found among domestic animals (q.v.). About the middle of the 19th century there was much enthusiasm for transplanting animals from one country to another; but the results have so often been harmful rather than beneficial to the recipients of the new forms that the effort to improve on nature in this way has been abandoned. Conspicuous examples are afforded by the sending of the European rabbit to Australia and New Zealand, where it multiplied so excessively in a favorable climate, with abundant food, and through the almost complete lack of enemies, as to become a nuisance and a menace to the pastoral industry. (See RABBIT.) The introduction of the agua toads, and afterward of the mungoos (qq.v.) into Jamaica, to subdue the rats that were devouring the sugar-cane, had evil results. The spread of the European house-sparrow (q.v.) in the United States is another pertinent example. Many highly injurious insects have been accidentally introduced and acclimatized in America from abroad; and the same is true of other countries. On the other hand a few instances like the acclimatization of the silkworm in Europe, of bumblebees in New Zealand, or of ladybirds in California, have been highly beneficial; while much good has come from stocking new streams with desirable fishes. Of the several societies founded to promote such transferences, that of Paris (Société d'Acclimatation) is most important, but latterly has been inactive.

In Human Beings. See HYGIENE.

Bibliography.— ‹Variations of Animals and Plants Under Domestication.› Darwin; ‹Island Life,› Wallace; ‹Tropical Colonization.›

Acco, ak'ō. See ACRE.

Accolade, äk-ō-låd' (Fr. «embrace,» literally, «on the neck»), in heraldry, the ceremony by which in mediæval times one was dubbed a knight. On the question what this was, antiquaries are not agreed. It has been made an embrace round the neck, a kiss, or a slight blow upon the cheek or shoulder. In some cases it was a literal box on the ear, for which later was substituted a gentle tap on the shoulder with the flat of a sword. In conferring knighthood Queen Victoria struck the kneeling subject lightly on the shoulder with a sword and used the words «I bid thee rise, Sir Knight.»

Accolti, Benedetto, äk-ol'tē, ben-a-det'ō, the Elder, distinguished Italian jurist: b. Arezzo, 1415; d. Florence, 1466. Several other members of his family were noted for legal attainments. He became professor of jurisprudence in the University of Florence, and on the death of the famous Poggio was made chancellor of that republic. With his brother Leonardo he wrote in Latin a three-volume history of the first crusade, not of great value, but interesting as having furnished Tasso the material for ‹Jerusalem Delivered›: pub. Venice 1452, Italian tr. 1543, French tr. 1620. He also wrote a volume of biographies of his distinguished contemporaries, pub. Parma 1689.

Accolti, Bernardo, äk-ol-tē, bĕr-nar'dō, Italian poet: b. Florence, before 1466; d. after 1534. He was greatly admired, especially as an improvisatore. Whenever he announced his intention of reciting his verses the shops were

closed and the people flocked in crowds to hear him. He was surrounded by prelates of the first eminence; a body of Swiss troops accompanied him; and the court was lighted by torches. Leo X. esteemed him highly and made him apostolic secretary, cardinal, and papal legate at Ancona. He it was who drew up the papal bull against Luther (1520). Though styled in his own day «The Only (one) of Arezzo» (L' Unico Aretino), the fame of his works perished with him. Their style is hard, his images forced, and his taste marred by affectation. The best known is a comedy, ‹La Virginia.› His other productions include some lyric poetry, epigrams, octaves, and verses in *terza rima*.

Accommodation, the process by which the mind is brought into adjustment with its surroundings; adaptation.

In physiology, the accommodation of the eye is the function by which objects, near or distant, may be seen distinctly. It is accomplished by the relaxing or contracting of the ciliary muscle. See Eye.

In biology, the process by which an organism becomes adapted to its environment.

In theology, properly, the presentation of a truth not absolutely, but with some modification to suit it either to some other truth or to the person addressed. It is distinguished as *formal* and *material,* the former relating to the method of teaching, and the latter to what is taught. The former includes teaching by parables or symbols, by progressive stages graduated to the capacity of the learner, etc.; more usually, now, the forcing of texts from their obvious meaning to conform them to theories derived from other sources. The latter, as now commonly used, means the theory that Christ and the writers of Scripture modified or perverted the truth to accommodate it to the limited intelligence or the prejudices of their times.— the cosmogonies of Genesis, or Jesus' acceptance of demoniac possession as a truth, etc.

In commerce it usually denotes temporary financial assistance rendered by one merchant or bank to another. Accommodation paper includes notes or bills of exchange made, accepted, or indorsed, without any consideration. While in the hands of the party to whom it is made, or for whose benefit the accommodation is given, such paper is open to the defense of want of consideration, but when received by third parties in the usual course of business it is governed by the same rules as other paper. (2 Duer, N. Y. 33; 2 Kent, Comm. 86.)

Accompaniment, in music, is that part which serves for the support of the principal melody (solo or obbligato part). This can be executed either by many instruments, by a few, or even by a single one; we have therefore pieces with an accompaniment for several, or only for a single instrument. The principles on which the effect of accompaniment rests are so little settled that its composition is perhaps more difficult than even that of the melody. Frequently the same musical thought produces a good or bad effect, according to the character of the accompaniment, without our being able to give a satisfactory reason for the difference. The accompaniment requires of the performer the most scrupulous study, and of the composer the greatest skill and delicacy. As the object of every musical accompaniment is to give effect to the principal part, the accompanist should always aim really to support and by no means to overpower it.

Accomplice is the term applied to one who is in some way connected with the commission of a crime, though not as a principal.

In the absence of a statute it is not a rule of law, but a rule of practice only, that a jury should not convict on the uncorroborated testimony of an accomplice. Ordinarily the judge will advise the jury to acquit unless the testimony of the accomplice is corroborated as to the circumstances of the offense and the participation of the accused. It is provided by the N. Y. Code Crim. Proc., § 399, that a conviction cannot be had upon the testimony of an accomplice unless he be corroborated by such other evidence as tends to connect the defendant with the commission of the crime. This statute has been adopted in many of the States of the Union.

Accoramboni, Vittoria, äk-o-räm-bō'nē, vit-ō'rē-a, an Italian lady famous for her beauty and her wild tragic history: date of birth unknown; d. 22 Dec. 1585. Her contemporaries thought her the most fascinating woman ever in Italy. Paolo Giordano Orsini, Duke of Bracciano, who was believed to have murdered his wife with his own hand, sought hers with her passionate acquiescence; but her father gave her to Francesco Peretti, nephew of Cardinal Montalto and living in his house. Peretti was assassinated 1581; and Vittoria fled to Bracciano; the scandal was great, and Gregory XIII. imprisoned her nearly a year in the castle of St. Angelo, but she married the duke as soon as released. Montalto becoming Pope as Sixtus V., the couple took refuge in Venetian territory. After a few months' residence at Salo on Lake Garda, the duke died, leaving her almost the whole of his great fortune; but an incensed relative of his, Ludovico Orsini, had her murdered at Padua, whither she had removed. This recital, valid on the evidence accessible up to now, and accepted by Gnoli in his «Life» of her (Florence 1870), leaves Vittoria much on the level of other passionate Italian women of her age; but the Countess Martinengo-Cesaresco has recently re-examined the evidence in her ‹Lombard Studies,› and thinks her innocent of complicity in crime. Much literary use has been made of her story, and Webster's play ‹The White Devil› is based on it.

Accord and Satisfaction signifies a satisfaction agreed upon between the party injured and the party injuring, which when performed is a bar to all actions upon this account. It must be legal. An agreement to stifle a criminal prosecution for a criminal offense such as an assault and imprisonment is void. (2 Wils. 241; 5 East. 294.)

Where a release is given to one of two joint tort-feasors which recites the receipt from him of a certain sum as full payment, it will operate as a bar to an action against the other tort-feasor. (136 Mass. 503.)

Accord with satisfaction, when completed, has two effects: it is a payment of the debt; and it is a species of sale of the thing given by the debtor to the creditor in satisfaction; but it

differs from it in this, that it is not valid until the delivery of the article, and there is no warranty of the thing thus sold, except perhaps the title; for in regard to this it cannot be doubted that if the debtor gave, on an accord and satisfaction, the goods of another, there would be no satisfaction. But the intention of the parties is of the utmost consequence. (30 Vt. 424.)

Accordion, a musical instrument in the form of a small box, generally from 8 to 12 in. long by 4 wide, and containing a number of metallic reeds fixed at one extremity, but left to vibrate freely. A small bellows, formed by a folding apparatus which unites the top and bottom of the box, supplies the wind, which, admitted by keys acting on valves, sets the reeds in vibration. In the harmonium (q.v.) and the American cabinet-organ the same principle is also employed. The accordion was introduced into America from Germany about 1828, but the principle has long been known in China, and employed for instruments played by the breath. The concertina, flutina, and organ-accordion are improvements.

Account, a register of pecuniary transactions, whether for personal use, to satisfy a contract, in obedience to law, or as a bill of items sent to a customer who buys on credit. A mutual account is one where debtor and creditor items are opposed between two parties. An open account, or account current, in commerce is one in which the balance has not been struck; in banking, one that may be added to or drawn upon at any time, as opposed to a deposit account, where notice is required for withdrawals. To keep an open account is to keep such a one running on, instead of closing it. A stated account is one which all parties have expressly or by implication (as by the debtor's retaining it beyond a reasonable time without objection) admitted to be correct. To open an account is to begin pecuniary transactions with a banker or merchant.

In law, an account is a detailed statement of the mutual demands in the nature of debt and credit between parties, arising out of contracts or some fiduciary relations. (32 Pa. St. 202; 1 Metc. (Mass.) 216.)

An open account is one in which some term of the contract is not settled by the parties, whether the account consists of one item or many. (1 Ala. N.S. 62.)

In equity, jurisdiction concurrent with courts of law is taken over matters of account (9 Johns. (N. Y.) 470; 1 Paige Ch. (N. Y.) 41) on three grounds: mutual accounts; dealings so complicated that they cannot be adjusted in a court of law; and the existence of a fiduciary relation between the parties.

Accountant, properly any one who keeps accounts, and till lately applied in the United States to all bookkeepers without distinction; more generally now restricted to the head bookkeepers of large houses or corporations, with difficult or complex accounts calling for expert ability. Especially an «expert accountant» or «public accountant» is understood as one not in the employ of any one house, but hiring his services out to such firms or companies, banks, or public institutions, as either find their accounts in disorder or wish a legal verification or a guaranteed statement for the public; or report on bankrupt estates under legal process. Few large financial institutions neglect to support public confidence by having their books periodically investigated and reported upon by an accountant unconnected with the concern. This is gradually building up, through many scandals and frauds upon the public, a much higher standard of professional duty among these experts: it is recognized that it is their duty not merely to certify to the correct balancing of the figures submitted to them, but to use reasonable intelligence and honorable purpose on the manner in which those figures were made, and whether they represent facts or gross fictions to deceive outsiders and lure in money to be mishandled. The proper, and in the United States the only, business of an accountant is to examine accounts and make out balance-sheets and statements. In England they assume a still further duty, that of managing estates and legacies.

Accretion, the increase of real estate by the addition of portions of soil, by gradual deposition through the operation of natural causes, to that already in possession of the owner. If an island in a non-navigable stream results from accretion, it belongs to the owner of the bank on the same side of the *filum aquæ*. (2 Washburn, Real Prop. 452; 3 Kent, Comm. 328; 6 Cow. (N. Y.) 537.) In some cases it has been held that it makes no difference whether the stream is navigable or not (24 How. (U. S.) 41; 10 Pet. 662) where the owner of land has received accretions thereto. The term «alluvion» is applied to the deposit itself, while «accretion» denotes the act.

Accrington, a manufacturing town and municipal borough of England, in Lancashire, on the Hyndburn, 20 m. N. of Manchester and 5 m. E. of Blackburn; on the Lancashire & Y. Ry.; inc. 1878. It is well laid out, and has various handsome buildings, including the town-hall, a splendid market hall, technical school and school of art, clubs, etc. The manufacture and printing of cottons, chemical works for their use, and the manufacture of spinning and other machinery, are the chief industries. Coal is wrought extensively. Pop. (1841) under 9,000; (1881) 31,435; (1901) 43,095. Accrington gives name to a parliamentary division of the county; pop. 84,878.

Ac'cum, Friedrich, frĕd'riн, German chemist: b. Bückeburg, 1769; d. Berlin, 1838. Removing to London at 24, eight years later he was made professor of chemistry and mineralogy at the Surrey Institution. He published several text-books on these sciences, but is remembered mainly for being (with an energetic print-seller, Ackermann) the introducer of gas-lighting into England. His ‹Practical Treatise on Gaslight› appeared in 1815. Another valuable service to society was his ‹Treatise on Adulterations of Food and Culinary Poisons› (1820). As the result of charges against his honesty he returned to Germany, and in 1822 was made professor in the Industrial Institute and Academy of Architecture in Berlin.

Accumulator, a device for the storage of energy, more particularly when the energy is supplied from an intermittent source, or when it is to be withdrawn intermittently or irregularly. The fly-wheel on a steam-engine is a device of

this sort, but it is not commonly referred to as an accumulator. The word is practically restricted to the following two senses: (1) a storage-battery (q.v.); (2) a hydraulic apparatus, commonly consisting of a plunger which is fitted to a vertical cylinder and heavily loaded with weights. Water is forced into the cylinder by pumps, with the result that the plunger and its weights are raised, and a considerable quantity of water is thus stored in the cylinder under a high pressure. By the use of such an accumulator it is possible to deliver water for a short time in far greater volume than the pumps feeding the accumulator could deliver it, and yet at the maximum pressure that the pumps are capable of producing. Hydraulic accumulators are used in connection with riveting-machines, cranes, and many other heavy tools.

Accusative Case, in Latin,— and thence applied to the corresponding case in Greek and other declensions,— that case of the noun, pronoun, etc., which designates the object to which the action of a verb is immediately directed. It corresponds with what, although the English noun is nearly without declension, is called in English the objective case. See DECLENSION.

Aceldama, a-sel'da-ma, a cemetery in Jerusalem used to bury strangers in. The traditional site is on a small plateau half-way up the southern slope of the valley of Hinnom, near its junction with the valley of Jehoshaphat; and it was certainly used in the 6th century for the burial of Christian pilgrims, and continued in use till the 17th. According to Matt. xxvii. 7, 8 it was bought by the chief priests and elders for a burial-ground, with the 30 pieces of silver returned by Judas after the betrayal; according to Acts i. 19 it was bought by Judas himself with the money, which he did not return, and his bowels burst open in it; according to both, the name means « the field of blood,» and it was a potter's. But as the Greek text gives a form « *Aceldamach,*» which would mean « field of sleep,» a natural and beautiful term for a burying-ground, and as according to Jer. xviii. 2 and xix. 2 there was a potter's in the valley of Hinnom, it would seem that the use and name of the place were very old at the time of Christ, and that the meaning « field of blood » was a misunderstanding, or a play on the real meaning, and its connection with Judas artificial. (History and description by Schick, 1892, quarterly statement of the Palestine Exploration Fund, pp. 283–9.)

Aceph'ali (« headless »), in civil history, certain levelers, in the reign of Henry I. of England, who acknowledged no head or emperor; or, according to another explanation, who were too poor to own any property, and so have any legal superior.

In Church history: (1) Bishops exempt from the jurisdiction and discipline of a patriarch. (2) Clergy belonging to no diocese. (3) Those who, on occasion of a dispute in the Council of Ephesus, A.D. 431, refused to follow either John of Antioch or Cyril of Alexandria. (4) Those who rejected the decision of the Council of Chalcedon, 451, on the nature of Christ. (5) In the 5th and 6th centuries, a large section of the followers of the Monophysite, Peter Mongus, who cast him off as their leader because of his accepting a peaceful formula called the Henoticon (q.v.). They soon afterward split into three parties, the Anthropomorphites, the Barsanuphites, and the Essianists, who again gave origin to other sects. (6) The Flagellants (q.v.).

Aceph'alocyst' («headless cyst»), a growth found in the liver, kidneys, and other glandular organs of man and oftentimes those of the lower animals. See TÆNIA.

Acer. See MAPLE; WHISTLEWOOD.

Aceratherium, ā-sĕ-ra-thē'ri-um, an extinct rhinoceros which inhabited Europe during the Miocene epoch. It had no distinct horn, whence the name (Gr. ἀ- without, κέρας horn, θήρ animal), but a small boss on the top of the skull indicates a rudimentary horn or callosity. American fossil hornless rhinoceroses formerly referred to this genus are now distinguished as Cænopus (q.v.).

Acerbi, Giuseppe, ä-chĕr'-bē, ju-sep'-a, Italian traveler and scientist: b. near Mantua, 3 May 1773; d. there August 1846. He studied at Mantua, devoting himself to natural science; in 1798 journeyed through Scandinavia, Finland, and Lapland, and in 1799 visited the North Cape, the first Italian ever there. On his return he stayed some time in England and published his « Travels » in English, later having them translated into French and German. He rendered great service to Italian literature by starting in 1816 the *Biblioteca Italiana*, which fought the Accademia della Crusca (q.v.). Made Austrian consul-general to Egypt in 1826, he contributed valuable articles on Egypt to the *Biblioteca*, and obtained many Oriental objects of interest to European museums. From 1836 till his death he lived at his native place.

Acerra, a-cherr'a, Italy (the ancient ACERRÆ, admitted to Roman citizenship 332 B.C., plundered and burnt by Hannibal): an episcopal city 9 m. N.E. of Naples, with which it is connected by railroad, and opposite Mt. Somma. It has a cathedral. The inundations of the neighboring Agno formerly made it very unhealthy, but the marshes are now drained. Pop. (1891) 13,633; (1901) 16,443.

Aces'tes, or **Æges'tus,** in Greek legend, son of Crinisus and Ægesta, and king of the country near Drepanum, in Sicily. He assisted Priam in the Trojan war, entertained Æneas during his voyage, and helped him to bury his father on Mount Eryx. In commemoration of this Æneas built a city there and called it Acesta.

Acetal. (1) A colorless, pleasant-smelling liquid, formed as a by-product in the preparation of aldehyde from alcohol, and occurring naturally in crude alcohol. Its formula is $CH_3.CH(OC_2H_5)_2$. It boils at 219° F. under ordinary atmospheric pressure. Its specific gravity is about 0.831, and its critical temperature is 490° F. Acetal mixes in all proportions with alcohol and ether. It is soluble in eighteen volumes of water at 80° F., and is more soluble at higher temperatures.

(2) « Acetal » is also used to signify any one of a group of compounds formed by the combination of one molecule of an aldehyde with two molecules of an alcohol, and the elimination of one molecule of water. They are obtained as by-products in the preparation of aldehydes from alcohols, a certain portion of the aldehyde formed combining with the unmodified alcohol.

Ac'etan'ilide (known in the drug trade as antifebrin), a crystalline compound obtained by the action of glacial acetic acid upon aniline (q.v.). Its formula is $C_6H_5NHCOCH_3$. It melts at 237° F., and boils at 563° F. without decomposition. It is readily soluble in alcohol and ether, and dissolves in hot water, but is only sparingly soluble in cold water. It is given in medicine as a sedative and febrifuge. Its physiological action is similar to that of antipyrin, but its administration is considered to be safer.

Ac'etates, compounds of acetic acid with metals or organic radicals. See ACETIC ACID.

Ace'tic Acid, an organic acid belonging in the fatty series, important on account both of its extensive use in the arts, and of its properties as viewed from the standpoint of the theoretical chemist. Its formula is CH_3COOH, or $C_2H_3O.OH$. It is a monobasic acid, the hydrogen in the radical CH_3 not being replaceable by a metal or another radical. In its dilute state it has been known for centuries as vinegar, and in strong vinegar the characteristic odor of the acid is quite marked. It may be formed by the oxidation, decomposition, and destructive distillation of many organic bodies. It is produced, as in the manufacture of cider vinegar, by the action of the microscopic plant *Mycoderma aceti,* better known as « mother-of-vinegar,» upon weak alcohol. In the manufacture of vinegar the alcohol required for the transformation is present in the cider as the result of a preliminary alcoholic fermentation. It has been shown that « mother-of-vinegar » has no effect upon pure alcohol, the reason for this being that a certain amount of albuminous and mineral matter must be present to serve as food for the plant. The greater part of the acetic acid of commerce is obtained by the destructive distillation of wood, acetate of lime being a by-product in the manufacture of wood-alcohol. (See WOOD-ALCOHOL, under ALCOHOL). The acetate of lime so obtained may be decomposed by the addition of sulphuric acid, when acetic acid is liberated, or it may be treated in any one of a number of other ways for the recovery of the acetic acid. One of the best methods consists in mixing the commercial acetate of lime with calcium chloride, and concentrating the solution until the compound known as calcium aceto-chloride ($CaC_2H_3O_2Cl.5H_2O$) crystallizes out. The crystals so formed are then dissolved in water, the solution is filtered through animal charcoal, more calcium chloride is added, and the operation is repeated to obtain a new crop of purer crystals. These crystals are finally distilled with moderately strong sulphuric acid, when a very pure acetic acid is given off.

By heating acetate of sodium with concentrated sulphuric acid it is possible to obtain acetic acid in a state free from water. The acid so obtained is a colorless liquid boiling at 244° F., and solidifying, at about 63° F., into an ice-like mass; from this property the anhydrous acid has been called *glacial* acetic acid.

Acetic acid is uninflammable in its liquid state, but its vapor burns with a fine blue flame. It is used as a solvent for organic substances, being a useful substitute for alcohol in certain cases on account of its relative cheapness.

Lead acetate (or sugar of lead) and copper acetate (or verdigris) are the most important compounds of acetic acid with the heavy metals. Aluminum acetate and the iron acetates are much used in dyeing. The acetates of lead, potassium, and ammonia are also largely used in medicine.

Acetic acid may be formed synthetically by exposing a mixture of one volume of acetylene (q.v.) and two volumes of air to daylight, in the presence of a weak solution of caustic potash. The acetylene is slowly oxidized, combining simultaneously with the caustic potash to form acetate of potash, according to the formula

$$\underset{\text{Acetylene}}{C_2H_2} + O + \underset{\text{Caustic potash}}{KOH} = \underset{\text{Acetate of potash}}{CH_3.COOK}$$

From the acetate of potash so formed the acetic acid can readily be obtained. This mode of formation is of no practical value, but it has a theoretical interest.

The relations of acetic acid with the organic radicals are too numerous and complicated to receive general treatment in the present article. The more important ones are noticed elsewhere. see ALDEHYDE; ALCOHOL; ETHER; etc.

Acetic Ether, or **Ethyl Acetate,** a colorless, inflammable liquid having the formula $CH_3.COO.C_2H_5$, or $C_4H_8O_2$, prepared by the action of sulphuric acid upon a mixture of alcohol and acetic acid. It has a specific gravity of about 0.91 and a specific heat of 0.48, and boils at 171° F., under the ordinary atmospheric pressure. It mixes readily with alcohol and with ether, and at ordinary temperatures is soluble in about 17 parts of water. See ESTERS; ETHER.

Ac'etin, a substance resembling fat in its constitution, obtained by acting upon glycerin with glacial acetic acid. Acetins are known as monoacetin, diacetin, and triacetin, according as the acetic acid has displaced one, two, or three of the hydroxyl molecules in the glycerin. The formula of monoacetin is $C_3H_5(OH)_2(OC_2H_3O)$; of diacetin, $C_3H_5(OH)(OC_2H_3O)_2$; of triacetin, $C_3H_5(OC_2H_3O)_3$.

Ace'to-ace'tic Acid, a thick acid liquid, having the formula $CH_3.CO.CH_2.COOH$. At 212° F. it splits up into carbon dioxide and acetone.

Ac'etone. (1) A limpid, mobile liquid with a taste suggestive of peppermint. Formula, $CH_3.CO.CH_3$. It occurs in crude wood-alcohol, from which it can be separated by distilling over calcium chloride. It is also obtained by the destructive distillation of acetates, notably those of barium and lead.

It occurs in the urine, blood, and brain of calcium diabetic patients. Lieben's test for acetone in the urine is as follows: Distilled urine is made alkaline by caustic potash, and a few drops of a solution of iodine and iodide of potassium are added. If acetone is present a yellow precipitate of iodoform is formed at once; if alcohol be present in the distillate, the same reaction takes place, but more slowly; but with acetone the reaction is immediate.

Acetone is very inflammable, and burns with a white smokeless flame. It boils at 133° F. at

ordinary atmospheric pressure; its specific gravity at ordinary temperatures is 0.800.

(2) Any one of a certain class of carbon compounds in which two alcoholic radicals are united by the group CO. These compounds are now called ketones (q.v.), to distinguish them from the particular member of the group defined in (1), above.

Ac'etoni'trile, a colorless liquid with a pleasant ethereal odor, and burning with a reddish-bordered flame. It has the formula C_2H_3N, and is isomeric with methyl cyanide. It is best prepared by distilling a mixture of potassium cyanide and potassium-methyl-sulphate. It boils at 178° F. at ordinary atmospheric pressure, and has a specific gravity of 0.79. It mixes with alcohol and water.

Ac'etyl, the radical of acetic acid, its formula being $CH_3.CO$. Acetic acid may be regarded as the hydrate of this radical, its formula being $CH_3.COOH$. Acetyl chloride, $CH_3.COCl$, is obtained by the action of phosphorustrichloride upon acetic acid. Acetyl chloride evolves hydrochloric acid when it is heated with any substance containing the radicals hydroxyl, amidogen, or imidogen, and hence it is of importance as a test for these substances.

Acet'ylene, a hydrocarbon gas, C_2H_2, commercially prepared by adding water to calcium carbide, when both decompose and recombine into acetylene and slaked lime. It was discovered in 1836 by Edmund Davy, when experimentally trying water on the impure carbide produced by distilling calcined potassium tartrate to obtain potassium; named by Berthelot, who in 1862 prepared it by red-heating ethylene, by electrically vaporizing carbon, and by incomplete combustion of coal-gas; the same year Wöhler produced the carbide by heating carbon with an alloy of calcium and zinc. Acetylene is also produced by the direct union of carbon and hydrogen when an electric arc is caused to pass between carbon terminals in an atmosphere of hydrogen. But both carbide and gas were laboratory curios till after 1892, when a new method of obtaining cheap carbide was accidentally discovered at the works of Thos. L. Willson, a Canadian, at Spray, N. C., and perfected by the chemist Dr. G. de Chalmot and the electrician J. M. Morehead; and not long afterward Prof. Henri Moissan of Paris independently discovered the same in essence,— the electric arc acting on mixed lime and carbon. This at once made the gas of great industrial importance for lighting, and the carbide as an agricultural germicide.

Acetylene is a colorless gas of an agreeable ether-like odor; but the impurities of commercial carbide give it often a garlicky smell. It is much less poisonous than coal-gas or water-gas, and practically harmless. It is .92 the weight of air, so that a 10-foot cube weighs upwards of 75 lbs. It takes fire at 896° F., and in the open air burns very smokily, with clouds of soot; but when consumed in a suitable burner, with a sufficient supply of air, it gives the whitest and clearest light of any common illuminant, the final products of its combustion being carbon dioxide and water vapor, with no trace of the poisonous carbon monoxide. At 1200° it changes to isomeric hydrocarbons, yielding benzene (C_6H_6) and tar; at 1400° it decomposes into its elements. It gives off much greater heat in combustion, volume for volume, than coal-gas; but light for light it gives off much less, owing to its vastly greater illuminating power and consequently much smaller volume to equal light. Mixtures of air and acetylene containing from 2.8 to 65 per cent of the gas are inflammable in the open, but in tubes the possibility of combustion striking through decreases with their diameter until it ceases at about one fifth of an inch.

Pure acetylene is sometimes objected to because the small dazzling point of light strains the eye unless hidden, and the black shadows diminish the real illuminating power. Various diluents have been tried; the only ones in practical service are oil-gas, which is used on all the Prussian government railroad lines, mixed with 20 per cent of acetylene under 10 atmospheres pressure; and air, which in the best burners (the Napheys, a Philadelphia invention of the Bunsen order) is thoroughly mixed with acetylene to secure perfect combustion and the best illumination. Prof. Vivian B. Lewes of England thinks methane or marsh gas by far the best; it is too costly by itself, but can be generated along with water gas so as to give a cheap mixture which a little acetylene enriches into a powerful light.

When added to coal-gas or water-gas in small proportions (5 per cent or so) acetylene does not increase the illuminating power of the mixture nearly as much as might be expected. When added in considerable proportions it becomes a most valuable enricher of coal-gas; but so is coal, and even the low cost of that is grudged.

Storage.— It has been desired to use the gas without the cost and trouble of installing and operating generators; and the two possible methods are to liquefy it and make a solution of it. The former has been done by a pressure of 39.76 atmospheres at 68°, making a liquid .33 the weight of water and 1-500 the volume of the gas; a jet allowed to escape evaporates so fast that the resultant cold of — 130° F. freezes part of the liquid to a white solid. It is shipped in steel cylinders containing 9 lbs. liquid, or ½ cu. ft., giving 250 feet of gas, equal to 3,000 feet of good coal-gas or some 6,000 of such as many cities give.

Frequent explosions of these, however, have caused insurance companies to put them under ban. According to some authorities these explosions have invariably been due to gross carelessness; but according to others, acetylene gas, when stored in the compressed state, is liable to explosive spontaneous decomposition. This last view may very possibly be correct, since acetylene, like nitro-glycerine, is an endothermic substance; that is, its formation directly from carbon and hydrogen is attended by the absorption of heat. These objections do not apply to acetylene, except when it is stored in considerable quantity or under a considerable pressure. Acetylene is usually produced as fast as it is consumed, so as to avoid storage so far as possible; but where this is impracticable it is much safer to keep the acetylene in solution than to store it in any quantity. At 68° F. water dissolves 1.1 its volume of acetylene, alcohol 6, acetone (q.v.) 15, or at 12 atmospheres 300;

besides, a rise of temperature makes much less increase of pressure within the vessel than with the liquid acetylene, and hence lessens the danger of storage and transportation. The acetone solution, also, cannot be exploded, which is the great public bugbear against acetylene.

Generators.— Prof. Lewes divides acetylene generators into four types: (1) where water drips on a mass of carbide (as in ordinary bicycle lamps); (2) where it rises against a basket of carbide in a bell, or (3) against layers of it in trays without a bell; (4) where carbide drops slowly into excess of water. The first two are liable to overheat, decomposing part of the acetylene, losing that much and spoiling the burners with tar; the third is better, the fourth best of all.

For small lamps acetylene is nearly confined to bicycles, where water is dropped on a heap of carbide; they are too small to be in danger from overheating, but are costly to use because the carbide remaining after each lighting is too mixed with refuse to use again. Household lamps are sold, but are not yet in favor.

The popular books on chemistry state that acetylene combines with copper, forming a compound which readily undergoes explosive decomposition; but in order to obtain this compound it is necessary to pass the gas into an ammoniacal solution of cuprous chloride. A red precipitate of cuprous acetylide, having the formula $C_2H_2Cu_2O$, is then formed, and this precipitate explodes violently upon percussion. A similar compound of silver is known. Acetylene will not directly attack any of the common metals or alloys, and hence the current fear of its being charged with explosive copper salts under the conditions of ordinary practice has no warrant.

Its commercial future belongs to the domain of prophecy, not of statistical fact. In theory a manufactured product like carbide cannot compete with a cheap native product like soft coal; and improvements in burners and cheap water-gas should greatly increase light and reduce cost.

On the other hand, the relatively enormous illuminating power of acetylene largely offsets the cost of the raw material. The use of acetylene for practical illumination is certainly extending, and the immense output of calcium carbide (q.v.) must find a market.

Achæa. See ACHAIA.

Achæi, ak-ī'ē, **Achaians,** ak-ā-yans, or **Achæans,** ak-e'ans, the descendants of the mythical Achæus, son of Xuthus and grandson of Helen; a generic term employed by Homer to designate the whole Hellenic host before Troy, and in poetic use applied to all the Greeks indiscriminately. They appear to have been that branch of the Greeks which inhabited southeastern Thessaly and northern Peloponnesus, and by the Dorian invasion were driven altogether beyond the Corinthian Gulf and cooped into a strip of Peloponnesus along its southern shore, where they were the nucleus of the later Achaian League. See ACHAIA.

Achæmenidæ, ak'ē-men'i-dē, the Greek name of the Persian dynasty (558–330 B.C.) founded by Cyrus the Great, including Cambyses, Darius I. and II., Xerxes, Artaxerxes, etc., and ended by Alexander the Great. The family took its name from an ancestor of Cyrus, found in Persian inscriptions as Haxamanisya, which the Greeks softened to Achæmenes (a-kē'men-ēz).

Achaia, ak-ā'ya, or **Achæa,** ak-ē'a, in Homer, southeastern Thessaly, where was Phthia, the home of Achilles. In later history, a strip of Peloponnesus along the southern shore of the Corinthian Gulf, rising from the coast to wooded hills abounding in beasts of the chase; the uplands were fertile with grapes, olives, and other fruits. The nome called Achaia (including Elis) in the modern Greek kingdom, the northwestern part of Morea with capital at Patras, is still so, except along the west coast, on the Ionian Sea. When it first appears in authentic history (Herodotus), it is a confederacy of twelve towns — Pellene, Ægeira, Ægæ, Bura, Helice, Ægium, Rhypes, Patræ, Pharæ, Olenus, Dyme, and Tritæa — headed by Helice, and keeping much to itself in Greek affairs. Helice was destroyed by an earthquake and swallowed by the waves 373 B.C., and Ægium succeeded to the hegemony; and at some time unknown Olenus was deserted.

The League took no share in the Peloponnesian war, but the Macedonian supremacy and the dynastic struggles after Alexander's death broke it up altogether. Some of the remaining ten towns were held by Macedonian garrisons, some by local tyrants; a state of disunion equally gratifying to Macedonia and intolerable to Greek patriots. In 280, when several kings were dead, Macedonia in confusion, and the great Pyrrhus absent in Italy, Patræ and Dyme, the two westernmost towns, formed an alliance; Tritæa and Pharæ joined them: and the new Achaian League, famous in history, which gave southern central Greece more than a century of order and good government, was begun. The cities probably drove out their garrisons or rulers, as later ones certainly did. Five years afterward Ægium expelled its garrison and joined the League; Bura was freed and its tyrant slain by its people and their exiled brethren, and joined also; and Iseas, tyrant of Ceryneia, seeing how events were trending, voluntarily surrendered his position with a guaranty of safety, and annexed the city to the League. Seven towns were now included; and the other three were recovered and annexed not long after. But all were small and poor; fortunately for the League, as it was thought too insignificant to molest, and grew up peacefully and solidly for some 30 years. The chief name in its early history is Markos of Ceryneia, who helped liberate Bura even before his own city was freed, and seems to have been the Washington of the League. But its first entrance into the rôle of a great Greek political force began with the expulsion in 249 of the tyrant of Sicyon by Aratus of that city, who induced it to join the League; it not only gained thereby the first city outside the old Achaian confederacy, and became more or less Pan-Greek, but gained Aratus, its second founder, and a statesman and administrator of high order, though his jealousy of other leaders and his military incompetency injured it deeply. A still greater accession came in 242, when Corinth expelled its Macedonian garrison and joined; and in 234 Lydiadas, tyrant of Megalopolis, the powerful city founded by Epaminondas, volun-

tarily resigned his place like Iseas and brought in his city, being made commander-in-chief of the League's army the next year. Before the century had begun its last quarter the League included all northern and central Peloponnesus, and many towns elsewhere.

The League was a federal union of absolutely independent States, each having equal power in the Council, which met twice a year — at first and for a long time in a grove near Ægium, but later, at Philopœmen's motion, in the League cities in rotation. The vote of each city was given as a unit, not by elected delegates, but by any of its citizens who were present, any one over 30 having a right to be so; attendance therefore naturally fell to the richer citizens with means and leisure, and the assembly was a rough representative body of the leading men. The union acted as a unit in foreign affairs, and there was a secretary to record the debates and resolutions. The head officer was the *strategos*, who was commander-in-chief and civil president at once; he had under him a *hipparchos* (cavalry commander) and *nauarchos* (admiral), and a board of ten *demiourgoi* as assistants in the Council.

The League of course had its internal feuds and discordances of policy; and the Ætolian League north of the Gulf (only half Greek, and wholly barbarian in instability and lack of pro-Greek feeling), which alternately allied itself with it and ravaged its territory, was a mischievous rival and enemy. But the League would probably have fully held its own till the Romans came, but for Sparta. Cleomenes II. had revolutionized that State, which had shrunk into the narrowest of oligarchies and could not maintain its position; he had turned it into a socialistic one, and wished to force the League to join him in a great Peloponnesian union, of which Sparta would be master, imposing both its foreign policy and perhaps its internal organization on the rest, and which would destroy the internal independence of the League and menace the possessions of every property-holder in it. The League was badly defeated by Cleomenes in the field, and was between hammer and anvil; for the only power which could save it was Macedonia, its natural foe and old master, and Antigonus Doson refused to give aid unless the citadel of Corinth, the key of Peloponnesus, held by the League, were given up to him. Aratus felt, however, that the suzerainty of Macedonia, now that the League was strong enough to prevent active tyranny, was a less evil than the mastery of Cleomenes; and by cunning management he induced the League to pay the price asked for Antigonus' help. Cleomenes was crushed at Sellasia, and his Spartan constitution came to an end, and the League became a dependency of Macedonia. Yet Aratus' policy was justified by events so far as the League was concerned: it did not suffer from Macedonian tyranny, though the chance of forming a united Greece was at an end. But that was probably as little possible under Cleomenes as under Macedonia.

In point of fact the destroying enemy was not Macedonia but Rome. Under the noble and able Philopœmen of Megalopolis, soldier and statesman of high rank, the League was prospering and giving the citizens an enviable government. But a pro-Roman policy prevailed, and Philopœmen left the country. In 198 it allied itself with Rome against Macedonia, and this was always the beginning of the end with the other party to a Roman alliance. There were wars against Sparta, and a struggle between Roman and anti-Roman partisans in the assembly, with Roman envoys and intriguers to fan the flames. Finally, in 167, the Romans deported the flower of the Achaian citizens to Italy, many of them being imprisoned, others — as the future historian Polybius (q.v.), then a youth of 18 — kept as hostages but given Roman advantages. The last struggle took place in 146, when Mummius defeated the League at Corinth, and the independence of Greece or any fraction of it was at an end. All southern and central Greece was made a Roman province called Achaia.

(The first-hand authority for the League is Polybius, unfortunately extant only in fragments: in some parts he is pieced out by Livy, passages of whose work are often obvious translations from Polybius. In English the one great work is E. A. Freeman's unfinished ‹History of Federal Government,› nearly all devoted to the Achaian League; London, 1863; reissued with a fragment on Federalism in Italy.)

Achaqua, ä-chä'kwa, a South American Indian tribe probably extinct, though a few hundreds, who lived in the upper Orinoco forests in northeastern Colombia, were still existent in 1850. They were utter savages, practising infanticide beyond the second child, polyandry, and tattooing.

Achard, Franz Karl, äн'art, fränts karl, German chemist and physicist: b. Berlin 28 April 1753; d. 1821. He published in 1780 the results of many and careful experiments on the adhesion of bodies. But later he devoted himself to the development of the beet-sugar manufacture, and after six years of laborious endeavor discovered the true method of separating the sugar from the plant. His process was of enormous service to the countries whom the Napoleonic blockade shut off from the West India sugars. He was afterward director of the class of physics in the Academy of Science in Berlin.

Achard, Louis Amédée Eugène, ăsh-ar, loo-ē am-ā-dā ė-zhān, French novelist: b. April 1814; d. 25 March 1875. Originally a merchant, he became a contributor to several Paris journals in 1838. After the revolution of 1848 he was active as a royalist political writer; 1848–72 the *Revue des Deux Mondes* brought out almost annually a new story from his pen. He depicts pre-eminently conflicts in family life and society. ‹Parisian Letters,› published in 1838 under the pseudonym of «Grimm,» made his reputation. Other works of his are: ‹Belle Rose› (1847), ‹The Royal Chase› (1849–50), ‹Castles in Spain› (1854), ‹The Shirt of Nessus› (1855), ‹Chains of Iron› (1867), ‹The Viper› (1874).

Acharnæ, a-kar'nē, a large town of Attica, where the Thirty Tyrants (q.v.) encamped when they marched against Thrasybulus; and where the Lacedæmonians, under their king Archidamus, pitched their tents when they made an irruption into Attica at the beginning of the Peloponnesian war. Aristophanes, in his comedy ‹The Acharnians›— where a citizen of

the place, sick of war, ravage, and the stoppage of trade, makes a treaty of peace with the Lacedæmonians on his own account — represents the inhabitants as charcoal-makers; and other comic writers stigmatize them as rough and boorish.

Achates, in the Æneid, a friend of Æneas, whose fidelity is depicted as so exemplary that *fidus Achates* (the faithful Achates) has become a proverb.

Acheen. See ACHIN.

Achelous, ak-e-lō'us (now ASPROPOTAMO, «White River»), the largest river in Greece: 130 m. long, and not navigable. It rises on the Pindus range, flows south in a boisterous torrent, forming the boundary between Ætolia and Acarnania, and empties into the Ionian Sea opposite Ithaca. In its lower course it is an alluvial stream, winding in great loops through very fertile and marshy plains; it comes from the mountains heavily laden with fine white mud, which it deposits along its banks and in the sea at its mouth, where it has formed a number of small islands.

In Greek legend, the son of Oceanus and Terra, or Tethys, god of the river. As one of the numerous suitors of Dejanira, daughter of Œneus, Achelous entered the lists against Hercules, and, being inferior, changed himself into a serpent and afterward into an ox. Hercules broke off one of his horns, and Achelous, being defeated, retired into his bed of water. The broken horn was given to the goddess of plenty.

Achen, Johann («Hans») **von,** ä'Hen, yō'hän fon, or **Acken,** ä'ken, German painter: b. Cologne, 1512; d. 1615. He studied at home, and at Venice under Kaspar Rems, and took service with the Bavarian court 1590; later went to Prague at the invitation of Emperor Rudolph II. The Protestant church at Cologne contains his ‹Crucifixion,› the cathedral at Bonn his ‹Entombment,› and among his other works are ‹Christ Raising the Widow's Son,› and ‹Truth Victorious under Protection of Justice.›

Achenbach, Andreas, ä'Hen-bäH, German landscape and marine painter: b. Cassel, 1815. He studied under the eminent Schadow at Düsseldorf, and became one of the leading artists of that school. He painted in Holland, along the Rhine, and in Norway, producing landscapes of rich coloring and intense realism. He was made R.A. in Berlin, and knight of the Legion of Honor in France; and took a first medal in Paris, 1855. Private galleries in the United States have many of his finest works.

His younger brother OSWALD, b. Düsseldorf 1827; d. 1 Feb. 1905, was also a landscape artist, esteemed of more ideal quality than Andreas; and his pictures of Switzerland, Italy, etc., were largely bought in the United States.

Achene, Achenium, Akene, a-kēn', etc. («not gaping»), a dry, hard, one-seeded fruit in which the wrappings of the seed set closely to it, forming almost a coat. The entire family of *Compositæ* are of this sort: the «seeds» of borage, the sunflower, thistle, dandelion, etc. Sometimes they are grouped on a common receptacle, called an *etærio;* as in the strawberry, where it is fleshy, the achenes being the «pits,» or in the centre of the buttercup, where they form the «fruit»; sometimes they are inclosed in the fleshy tube of the calyx, as in the rose.

Achensee, ä'Hen-zā, a lake in N. Tyrol, Austria, 5½ m. long by ½ m. wide, 20 m. N.E. of Innsbruck. Its shores are of great beauty, and it is a noted summer resort, having many hotels and private villas, while steamers carry passengers to points of interest.

Achenwall, Gottfried, ä'Hen-väl, got'frēd, German statistician: b. Elbing, 20 Oct. 1719; d. Göttingen, 1 May 1772. He studied at Jena, Halle, and Leipzig, and became professor of philosophy, and later of law, at Göttingen. In economics he belongs to the school of «moderate mercantilists»; but it is in statistics that he holds a really high place. The work by which he is best known is his ‹Constitution of the Present Leading European States› (1752). In this he gives a comprehensive view of the constitutions of the various countries, describes the condition of their agriculture, manufactures, and commerce, and frequently supplies statistics in relation to these subjects. German economists claim for him the title of «Father of Statistics»; but English writers dispute this, asserting that it ignores the prior claims of Petty, and other earlier writers on the subject. He gave currency to the term *Staatswissenschaft* (politics), which he proposed should mean all the knowledge necessary to statecraft or statesmanship.

Acheron, ȧk'e-ron, the ancient name of several rivers in Greece and Italy, all connected by legend with the lower world. The principal was a river of Thesprotia in Epirus, which passes through Lake Acherusia, receives the Cocytus (Vuvó), and flows into the Ionian Sea south of the promontory of Chimerium, at Glycys Limen or Elæa, now Port Fanari. At one part its course lies between mountains rising precipitously to the height of 3,000 feet. The name is also given to a river of Elis, a tributary of the Alpheus, and to a small river of Bruttium, in Italy, near Pandosia (location uncertain), near which Alexander of Epirus fell in battle against the Lucanians and Bruttians (326 B.C.). Their legendary celebrity appears to have been originally due to the Acheron in Thesprotia. This country being regarded by the Greeks as the end of the world in the West, they supposed the entrance to the lower world to be here. As this district became better known, the legendary river was placed elsewhere, and finally transferred to the lower regions. In Homer, Acheron is represented as a river of Hades. According to later traditions a son of Helios and Gæa or Demeter, who bore this name, was changed into an infernal river as a punishment for giving drink to the Titans during their war with Zeus. The Etruscans are said to have worshipped Acheron. The name of Acheron was ultimately used in a poetic or figurative way to designate the whole of the lower world.

Acherontia Atropos. See DEATH'S HEAD MOTH.

À Cheval. See TACTICS.

Achillea. See YARROW.

Achilles, a-kil'ēz, one of the heroes of Greek mythology, and in particular the hero of Homer's Iliad. According to the latter he was the son of Peleus, king of the Myrmidons in Phthiotis, a district of Thessaly, and of the Nereid or sea-goddess Thetis, and the grandson

of Æacus; hence often called Peleides and Æacides. He was educated from childhood by Phœnix, a friend of his father, who accompanied him to the Trojan war; and Cheiron the centaur instructed him in the art of healing. Achilles went to this war with the knowledge that he was to perish in it; his mother having foretold him that he should either live a long and inglorious life, or die young after a glorious career. He led his troops, the Myrmidons, against Troy in 50 ships. During the first nine years of the war we have no minute detail of his actions; in the tenth a quarrel broke out between him and the general-in-chief, Agamemnon, which led him to withdraw entirely from the contest. In consequence the Trojans, who before scarcely ventured without their walls, now waged battle in the plain with various issue, till they reduced the Greeks to extreme distress. The Greek council of war sent its most influential members to soothe Achilles' anger, and induce him to return to arms, but without effect. Rage and grief caused by the death of his friend Patroclus, slain by Hector, induced Achilles to return to battle. Thetis procured from Hephæstus (Vulcan) a fresh suit of armor for her son, who at the close of a day of slaughter killed Hector and dragged him at his chariot wheels to the camp, but afterward gave the body to Priam, who came in person for it. Achilles then performed the funeral rites of Patroclus, with which the Iliad closes. It contains, however, several anticipative allusions to the death of Achilles, which is also mentioned in the Odyssey. He was killed in a battle at the Scæan Gate.

Here ends the history of Achilles so far as it is derived from Homer. By later authors a variety of fable is mixed up with it; some perhaps old legend, much certainly outright invention. To make him immortal, his mother during his infancy concealed him by night in fire, to destroy the mortal parts inherited from his father, and anointed him by day with ambrosia (the story of Demeter and Demophoön). His father discovering him one night in the fire, Thetis fled; and his father entrusted him to the care of Cheiron, who fed him with the hearts of lions and the marrow of bears, and gave him the education proper to a hero. According to another story Thetis made him invulnerable by dipping him in the Styx, but the heel by which she held him was untouched by the water; accordingly he received his fatal wound in the heel. The story of Siegfried is patterned on this. To prevent his going to Troy, where it was predicted he should perish, Thetis sent him, disguised as a girl, to the court of Lycomedes of Scyros. He was educated with Lycomedes' daughters, one of whom, Deidameia, became the mother of Pyrrhus or Neoptolemus by him. Odysseus (Ulysses) went to the court of Lycomedes to discover him and induce him to join the war, in which Calchas had declared his aid indispensable. He succeeded by a stratagem. Presenting himself as a merchant, he offered the daughters of Lycomedes female ornaments and articles of attire for sale, among which he laid a shield and spear. He then raised an alarm of danger, on which the girls fled, and Achilles seized the weapons. He is said to have been killed either by Apollo in the likeness of Paris, or by an arrow of Paris directed by Apollo. According to another account he made love to Polyxena, a daughter of Priam; and, induced by the promise of her hand on condition of his joining the Trojans, went unarmed to the temple of Apollo at Thymbra, and was there assassinated by Paris. Various stories are told of the relations of Achilles with Iphigenia (q.v.), who was brought to the camp at Aulis on pretext of being married to Achilles. In one account Achilles interferes to rescue her from being sacrificed, and sends her to Scythia; in another he marries her, and she becomes the mother of Pyrrhus. Others say he was united to her in the lower world, where he became a judge; others again say he married Medea in Elysium. Annual sacrifices were offered to Achilles by the Thessalians at Troas by command of the oracle of Dodona; at Olympia and other places in Greece sacred honors were likewise paid to him. This has led to the unsafe inference that he was originally an Achaian god; but remembering the propensity of uncivilized races to deify superior geniuses among them, and such cases as that of Roland, it is much more likely that he was a chief before he was a god. It is probable that a real Thessalian warrior existed who has been thus idealized, though we do not know his name or real deeds.

Achilles Tatius, a-kil'ēz tā'shi-us, a Greek writer of romances: b. in Alexandria; flourished in the 5th century of our era. Suidas says he was a Christian bishop, but this is doubted. He wrote ‹The Loves of Clitophon and Leucippe,› an erotic story in eight books, of pleasing but florid style, and without much regard to unity or consistency of plot; it was modeled on Heliodorus' ‹Ethiopica.› That the story was very popular in its day is proved by the number of copies of it that are still in MSS., and by the plentiful imitations of it in the Middle Ages. An English translation by Anthony Hodges was published in 1638.

Achilles Tendon, a tendon, so called because, as fable reports, Thetis, the mother of Achilles, held him by that part when she dipped him in the river Styx to make him invulnerable. It is the strong and powerful tendon of the heel, which is formed by the junction of divers muscles, and which extends from the calf to the heel. When this tendon is unfortunately cut or ruptured, as it may be in consequence of a violent exertion or spasm of the muscles of which it is a continuation, the use of the leg is immediately lost; and unless the part be afterward successfully united the patient will remain a cripple for life. The indications are to bring the ends of the divided parts together, and to keep them so until they have become firmly united. This tendon is frequently the seat of a synovitis, just above the heel, from excessive exercise.

Achimenes, a-kĭm'e-nēz (from the Greek name of an East Indian plant used in magic), a genus of tropical American plants of the order *Gesneraceæ*, greatly cultivated in greenhouses for the beauty of their red, white, and blue flowers, which, if the rhizomes are potted by the first of April, bloom from the last of May till into October or even November. It may also be propagated by cuttings. The species are numerous.

Achin, Acheen, or **Atcheen,** a-chēn′ (properly *Acheh,* Portuguese corruption *Achem,* Dutch *Atjeh* or *Ajeh*), a district at the N.W. extremity of Sumatra, till 1873 an independent sultanate, now a province of the Dutch Indies: area, 20,471 sq. m.; pop. (1897) stated at 531,705 (but a true census must be impossible). The surface is divided into an eastern and a western half by a mountain chain which traverses the whole island, rising in the peak of Abong-Abong to 11,000 feet. At the farthest north is the famous Gold Mountain, at the base of which lies the capital. On both sides are numerous stretches of level or undulating soil, watered by small but deep streams, and admirably adapted for tree-culture, gardening, and rice. The flora and fauna agree with those of Sumatra: pepper-trees and areca-nuts grow there. The natives employ themselves in agriculture, cattle-rearing, trade, fisheries, weaving cloth, and working in gold, silver, and iron. The chief agricultural industry is the production of rice and pepper, the latter sent from many small western ports. From Pedir and other northern ports large quantities of betel-nut are exported to India, Burmah, and China. Achin ponies are also much reputed and exported. Minor exports are sulphur, iron, sapan-wood, gutta-percha, dammer, rattans, bamboos, benzoin, and camphor, the latter highly valued in China and bringing an enormous price. Silk, once plentiful, has nearly disappeared. Nor is there now much export of the gold that once drew so much trade thither and made it so rich as to astonish foreigners. No place in the East save Japan was so abundantly supplied with it, and it was from far antiquity part of the Golden Chersonese. It exported probably 15,000 to 20,000 ounces a year. The imports are mainly rice (the native supply being insufficient), opium, salt, dried fish, cotton goods, iron and copper wares, firearms, pottery, etc. The people are distinct from the rest of the Sumatrans, who are Malays: they are taller, handsomer, and darker, more active and industrious, and good seamen; but they are treacherous, bloodthirsty, and revengeful, immoral, and inordinately addicted to opium. Their ethnological place is not settled; they are believed to be Malay at root, though probably with some admixture from India, and not impossibly an Arab strain. Their speech is said by some to be Polynesian at root, though with much Malay loan element. Their literature is entirely Malay, and comprises poetry, theology, and chronicles.

The capital of the province is Kota Radja or Achin, situated at the northwest extremity, on a stream navigable by boats, about 4½ miles from its port Oleh-leh, with which, since 1876, it has been connected by a railway. Formerly a large and flourishing city, it was almost entirely destroyed during the war, but is now beginning to revive. It contains a Dutch garrison of 2,000 men.

History.— Civilization was first introduced into Sumatra by Hindu missionaries in the 7th century, and a considerable amount of immigration from India followed. In the 13th century it was converted to Mohammedanism by Arabs — the sultans of Achin claim descent from the first Mohammedan missionary — and the Arabic alphabet displaced the Japanese. Northern Sumatra was visited by several European travelers in the Middle Ages, as Marco Polo, Friar Odorico, and Nicolo Conti; and some of these, as well as Asiatic writers, mention Lambri, a State which must have corresponded nearly with Achin: but the first to name it as such is Alvaro Tellez, a captain of the Portuguese Tristan d'Acunha's fleet, in 1506. It was then a dependency of Pedir adjoining; but within twenty years it had not only gained independence, but swallowed up all the other States of northern Sumatra. It attained the climax of power under Sultan Iskandar Muda, 1607–36, when it extended from Aru, opposite Malacca, round by the north to Padang on the western coast, a seaboard of 1,100 miles; and its supremacy was owned also by the large island of Nyas, and by the continental Malay States of Johór, Pahang, Quedah, and Perak. It is in fact the only Sumatran State which has at any time been powerful since the Cape route to the East was discovered. Its wealth astonished the European visitors and traders; and its great commercial repute is shown by the fact that it was to Achin port that the first Dutch (1599) and English (1602) commercial ventures were directed. Lancaster, the English commodore, carried letters from Queen Elizabeth to «the king of Atcheen.» James I. exchanged letters with Iskandar Muda in 1613, and the Achinese sent envoys to the Dutch republic, who were received by Prince Maurice in camp (1602). But native jealousy of foreigners and the latter's rivalry with and destruction of each other's ventures prevented the establishment of permanent factories there. Still, the trade, though spasmodically interrupted, was very important; foreign merchants of many nations were settled in Achin city port, while other Chinese merchants came annually and held a great fair through June and July. For 58 years after Iskandar's death the Malay oligarchy of chiefs placed females on the throne; in 1699 the Arab party suppressed this system and set up an Arab ruler, and the State rapidly decayed from internal factions. From 1666 on, the Dutch had held possessions around Padang on the western coast, and gradually gained much in old Achin; in 1811 the British seized this as well as the other Dutch East Indies. In 1816 Java was restored to the Dutch, but the English colonies insisted the more strenuously that English influence should be maintained in Achin; and in 1819 the Calcutta government made a treaty excluding all other foreigners from permanent settlements there. In 1824 an exchange was made with the Dutch, of the Sumatran settlements for others in Asia; the above article was not mentioned, but it was privately understood that it should not be insisted on if the Dutch would make no war on Achin. In the convention at The Hague, 2 Nov. 1871, the Dutch insisted on the latter stipulation being formally withdrawn, as the Achinese were pirates and chastisement was often needed: and in 1873 Holland — with plenty of provocation, but grave doubts even at home of its necessity — embarked in the war, which has cost it 15,000 lives and over $100,000,000, and has not yet ended in the real subjugation of the interior country. Achin city was captured and civil government has been instituted in the coast territory; but the natives are fierce and have a good country for guerrilla warfare, and English blockade-runners

keep them supplied with arms and ammunition. Many evidences of these wars may be seen in Holland. (The authoritative works are all in Dutch: the chief is Smouck's 'Die Ajehers,' 2 vols. Batavia 1893-5. There was also one of Veth, 'Atchin,' Leyden 1873.)

Achish, king of Gath in Philistia, with whom David takes refuge when out of favor with Saul; represented as a dull easy man, whom David dupes into believing that he is making war only on the Judahites and their allies, when in fact he is raiding the native tribes, and enriching his stronghold Ziklag with their plunder. His lords are not so blind, however, and make him dismiss David before going to battle at Mount Gilboa. David lived with him four months according to one account, a year and four months according to another.

Achromatism. Because the several components of a beam of ordinary light are of different refrangibilities, it follows that they are not brought to a common focus by a simple convex lens. The violet rays meet at a point nearer the lens than that at which the red rays unite, and the optical image is confused and fringed with prismatic colors.

This difficulty is greatest with lenses of short focus, whence the early practice of constructing telescopes of enormous length. Sir Isaac Newton, misled by a really remarkable series of petty accidents, concluded that this difficulty could not be obviated, and that large refracting telescopes were therefore impracticable. He therefore gave his attention to the development of the reflector.

In 1757, however, John Dollond, a Spitalfields weaver, discovered that different substances separate the colors of light, for a given mean refraction, to a different degree. He therefore constructed double lenses of two different kinds of glass,— crown glass and flint glass. A concave lens of flint glass brings the colors together while not entirely destroying the refraction caused by a convex lens of crown glass. The correction is far from perfect, however, and even the best telescope lenses produce a blue halo surrounding the stellar images. This outstanding color may be reduced by combinations of three or more lenses; but such devices greatly increase the mechanical difficulties of the optician. The present practice is to bring together such portions of the light as most powerfully effect the eye or the photographic plate, leaving the other tints uncorrected. The introduction of new kinds of glass, especially the Jena glass, so called, has somewhat improved the chromatic correction of smaller objectives. See DISPERSION; LENS; MICROSCOPE; TELESCOPE; LIGHT.

Achsharumov, Nikolei Dmitriyevich, äch-shä-roo'mōf, nē-kōlAI dmē-trē-yev'ich, Russian novelist and critic: b. St. Petersburg, 15 Dec. 1819; d. Moscow, 30 Aug. 1893. For a time he held a post in the ministry of war, but came later to devote himself to painting, and particularly to literature. He first attracted attention by a dramatic sketch, 'The Masked Ball,' and became more widely known through his novels, 'The Double'; 'The Gambler'; 'The False Name'; 'An Unusual Case'; 'The Mandarin'; and 'At All Costs' ('Was es auch Kosten mag'). His critical essays include studies of Tolstoi, Turgeniev, Dostoievski, and Herbert Spencer.

A Chula, ä-shoo'la (Port.), a dance resembling the fandango (q.v.).

Achurch, Janet, English actress: stage name of Janet Achurch Sharp, now Mrs. Charles Charrington: b. Lancashire; début at Olympic Theatre, January 1883. In 1887 she joined Beerbohm Tree's company; 7 June 1889 created the part of Nora in Ibsen's 'Doll's House,' the first presentation of Ibsen in English. She afterward starred in India and Australia, and in 1895 came to the United States, acting with Richard Mansfield and for herself. June 1897 she played Cleopatra (Shakespeare's) at the Olympic Theatre, London.

Acic'ulite, a mineral better known as needle-ore (q.v.).

Acidaspis («spine-shield»), a small trilobite widely distributed through Silurian and Devonian rocks, whose striking characteristic is the thick setting of the dorsal shield with such numerous and formidable spines that it must have been almost impossible for even much larger enemies to prey on it. The head-shield is entirely different from that of other trilobites, the trilobation being obscured by extra furrows and longitudinal false furrows. The thorax has 9 or 10 segments, each with long lateral spines and two shorter median ones; the small tail-shield in nearly all species also has them; in some a row of slender ones on the sides of the head-shield, and a long one projecting from each posterior angle; and from the middle posterior edge two long ones, straight or curved, often project upward and backward. A few species have the eyes placed, like some crabs and lobsters, on the ends of long, slender stalks, commanding a view in all directions.

Ac'idim'etry. See CHEMICAL ANALYSIS.

Acids. In popular usage, acids are substances of a corrosive nature, with a sour taste when diluted sufficiently to lose their corrosive action on the tongue, capable of turning certain blue vegetable coloring matters, such as litmus, to a red, and forming neutral compounds with alkalies. In modern chemistry an acid is usually regarded as a salt of hydrogen in which one or more of the hydrogen atoms are replaceable by metallic atoms or by organic radicals. An acid containing one such atom of replaceable hydrogen is called monobasic; if it has two such atoms of hydrogen it is called dibasic or bibasic; if three, tribasic; and so on. Hydrochloric acid, HCl, is a familiar example of a monobasic acid; it has only one atom of hydrogen that can be replaced by potassium (for example), with the formation of the single compound KCl. Sulphuric acid, H_2SO_4, is a familiar dibasic acid; with potassium it forms the two compounds $HKSO_4$ (hydrogen potassium sulphate), and K_2SO_4 (normal or basic potassium sulphate). Phosphoric acid, H_3PO_4, is a tribasic acid in which one, two, or all three of the hydrogen atoms may be replaced by metals or radicals. In a polybasic acid the hydrogen atoms need not necessarily all be displaced by the same element or radicals; thus microcosmic salt is a phosphate of hydrogen, sodium, and ammonium, with the formula $HNa(NH_4)PO_4 + 4H_2O$.

When an acid contains oxygen it is commonly named for the substance that is present with the oxygen and hydrogen in the acid. For example, nitric acid is named for nitrogen, and phosphoric acid for phosphorus. It often happens that the same element forms more than one acid with oxygen and hydrogen. In these cases it is usual to give the termination *-ic* to the one which contains the larger amount of oxygen, and the termination *-ous* to the one containing the lesser amount of oxygen. For example, H_2SO_4 is called sulphur*ic* acid, while H_2SO_3 is called sulphur*ous* acid. The salts formed by acids ending in *-ic* have the ending *-ate*, such as the acid sulphate of potassium, produced by substituting the metal potassium for one of the hydrogen atoms of sulphuric acid, while those formed by acids ending in *-ous* have the ending *-ite*. A vast number of organic acids are known, of which acetic acid is a familiar illustration.

Acknowledgment, the act of one who has executed a deed, in going before some competent officer or court and declaring it to be his act and deed. The function of an acknowledgment is twofold: to authorize the deed to be given in evidence without further proof of its execution, and to entitle it to be recorded. The same end may be attained by a subscribing witness going before the officer or court, and making oath to the fact of execution, which is certified in the same manner, but in some States this is permitted only in case of the death, absence, or refusal of the grantor. The certificate should be in substantially the following form:

——— —, 19—.

I, ——— ———, hereby certify that ——— ———, whose name is signed to the foregoing conveyance, and who is known to me, acknowledged before me on this day that being informed of the contents of the conveyance, he executed the same voluntarily on the day the same bears date.
Given under my hand this —— day of ——, 19—.

In many of the States it is necessary that a married woman be examined separately and apart from her husband touching her voluntary execution of the deed, and the fact of such examination must be included in the certificate.

Acland, Lady Christian Henrietta Caroline Fox, commonly called «Lady Harriet»; daughter of the first Earl of Ilchester: b. 3 Jan. 1750; d. 21 July 1815. She married Maj. John Dyke Acland, September 1770, accompanied him to America, and shared Burgoyne's campaign of 1777 with him. He being wounded and carried prisoner into the American lines in the second battle of Saratoga, 7 October, she left the British camp by night in a small rowboat and in a driving storm to rejoin him, with her chaplain and maid; was cordially received by Gates and nursed her husband back to health. Acland reciprocated the kindness when on parole in New York, by helping to relieve the sufferings of American prisoners. He died of a paralytic stroke 2 Dec. 1778; the gratifying story that he was killed in a duel for defending American courage against aspersion being pure invention. Equally untrue is it that she went insane and afterward married Chaplain Brudenell; she died Acland's widow. She was a graceful and elegant woman and is remembered for her charities.

Acland, Sir Henry Wentworth Dyke, English sanitarian: b. 1815; d. 16 Oct. 1900. He was long an expert on cholera and the various forms of plague. He was professor of medicine at Oxford (1858–94), besides serving on various sanitary bodies. He was one of the founders of the Oxford University Museum, and with Ruskin published an account of its objects (1859). He accompanied the Prince of Wales to America in 1860. He was author of 'Memoirs of the Cholera,' etc.

Aclin'ic Line, an imaginary line on the surface of the earth, at every point of which the magnetic dip is zero. It is irregular in shape, and its shape and position vary somewhat from year to year; but, roughly speaking, it lies close to the equator. See MAGNETISM, TERRESTRIAL.

Ac'mite, a mineral, in Dana's pyroxene group, crystallizing in the monoclinic system, and having essentially the composition $Na_2O.Fe_2O_3.4SiO_2$. Hardness 6 to 6.5; sp. gr. 3.5; lustre vitreous, inclining to resinous; usual color dark blackish-green or reddish-brown. Occurs in slender lustrous prisms in the elæolite-syenites of Norway, Greenland and Arkansas.

Acne, a disease of the sebaceous glands of the skin and of the hair follicles about them, characterized by an infection, an inflammation, and a breaking down of the tissue about the gland. Three main varieties are described, simple acne, deep or indurated acne, and acne rosacea, which is a complex affair.

Acne simplex.— In this form the affection is superficial, is found usually about the time of puberty, and is more often found in young women. It is a result of the great activities of the skin at this period of development, and is normal if not excessively developed. The «blackhead» or comedo is the first stage. This consists of the swollen sebaceous gland, slightly blackened at its outlet. This swelling continues, and a pustule forms, by reason of infection by one of the many pus-producing bacteria lying in and upon the skin. This results in an inflamed pimple, which may burst and discharge its contents, leaving a scar. In a badly inflamed area or pimply skin all stages of this development are usually present.

Acne indurata is a more deep-seated form. Here the gland lies deep in the skin, and, as it inflames, gives rise to the feeling of shot beneath the skin. These deep glands rarely rupture through the skin unless irritated by squeezing, in which instance they frequently form small boil-like pimples.

Acne rosacea is a combination of a disease of the skin, rosacea, plus an acne. This is the type of diseased nose so commonly termed a «rum-blossom.»

Acoma, ä-kō'ma, New Mexico (the old Spanish Acuña or Acuco), in Valencia co., 60 m. S.W. of Albuquerque and 15 m. S.W. of Lagun. It is an Indian pueblo of 492 people (566 in 1890), famed especially for its original site, the «Enchanted Mesa»: a rock table 430 feet high, accessible now only by scaling, and of old (traditionally) by spiral stairs cut in the stone, in a deep cleft of the upper portion and along a huge detached fragment leaning against it from the bottom, itself reached by a tall tree or a ladder, furnishing a secure fortress against enemies. The Indian tradition is that a long storm washed the loose earth away from the foot of the lower rock while all the tribe except

two women were away in the fields, and it fell over into the plain, leaving the upper portion inaccessible; the women perished, but the remainder of the tribe built a new place on the present site, which is the same as when the Spaniards found it. The essence of the tradition is verified by the finding of an old trail, and of shards, etc., in the talus high around the base. Acoma was visited in 1540 by Alvarado, of Coronado's command, and in 1582 by Espejo, who estimated the population at about 5,000. The Indians under Zutucapan stubbornly resisted the Spaniards, and in 1599 defeated a band of them from Oñate's force; later in the same year Zaldivar captured Acoma and slew five sixths of the inhabitants. A Spanish mission was afterward set up for the small remnant. (H. H. Bancroft's ‹Arizona and New Mexico,› 1880; F. W. Hodge, ‹The Enchanted Mesa,› ‹National Geographic Magazine,› vol. 8.)

Aconcagua, Chile, ä-kōn-kä'gwa (Sp.-Am. pron. kä'wä). (1) An extinct volcano in the S. Andes, on Chilean territory and dividing it from Argentina; one of the highest summits in the western hemisphere, estimated at about 23,000 or sometimes nearly 24,000 feet. (2) A river about 200 miles long, rising on the southern slope of the above mountain, and emptying into the Pacific 12 miles north of Valparaiso. (3) A central province of Chile, bounded N. by Coquimbo, S. by Santiago, E. by Argentina, S.W. by Valparaiso. For route of Trans-Andine Railway, via Uspallata pass in this province, see SOUTH AMERICA. The valleys are very fertile, vineyards and orchards are plentiful, and in summer numerous flocks are pastured on the mountain slopes; figs, nectarines, peaches, etc., are sent to Santiago and Valparaiso. Copper, silver, and gold are found. Area, 6,226 square miles. Pop. about 135,000. Capital, San Felipe.

Aconite (*Aconitum*), a genus of hardy herbaceous plants, of the natural order *Ranunculaceæ*, long known for their poisonous properties. Many of them are of great beauty, and several are cultivated, especially the common wolf's-bane or monk's-hood (*A. napellus*), so called from the form of its flowers, characteristic of the genus, which are shaped like a helmet or hood. The United States has also several species growing wild. The wild monk's-hood (*A. uncinatum*) is common in rich shady soils along the margins of streams as far west as Wisconsin, its blue flowers being one of the marked features of the summer's bloom. Trailing wolf's-bane (*A. reclinatum*), a white-flowered variety, grows in the southern Alleghanies. The winter aconite (*Eranthis*), with yellow flowers, is common throughout the Rocky Mountain regions extending to the Pacific coast. It is perhaps more closely related to the hellebores. These flowers hang clustered round an upright stalk and make the aconite a very imposing plant. Some powerful medicines are prepared from the leaves and roots of monk's-hood. Applied externally they produce numbness of sensory nerves, and are used to relieve pain in certain forms of neuralgia, and in acute and chronic rheumatism. Given internally they diminish the force and frequency of the heart's action, render breathing slower, and are employed in acute fevers and inflammations. A poisonous dose causes cessation of breathing and of the heart's action. All the plants of this genus are poisonous; common monk's-hood is very virulent; but the most deadly seems to be the *A. ferox*, the *bish*, or *bikh*, of Nepal.

Aconitic Acid, (also called equisetic or citridic acid), a tribasic acid having the formula $C_3H_3(COOH)_3$, the calcium salt of which occurs in several plants of the genus *Aconitum*, and in the common *Equisetum*, or horsetail. The acid itself is most easily prepared by the dry distillation of citric acid.

Aconitine, a powerful vegetable alkaloid found in the tuberous root of *Aconitum napellus* and other species of *Aconitum*. In its chemical structure it is an acetyl-benzoyl-aconine, $C_{21}H_{27}(OCH_3)_4NO_5.\left\{\begin{matrix}CO.CH_3\\COC_6H_5\end{matrix}\right.$, or, expressed in simple form, $C_{34}H_{47}NO_{11}$ (Freund and Beck). It is one of the most deadly poisons and has been known for hundreds of years. Its action as a medicine was first carefully studied by Stoerck in 1762. When locally applied it produces the constitutional symptoms. Its local use in the form of an ointment is of service in neuralgias. Internally its main action is on the heart muscle and on the blood-vessels. It slows the heart and dilates the blood-vessels, causing a marked decrease of blood pressure. It is because of this action that it is so widely used in the acute stages of many affections that are accompanied by a rapid heart and a tense, bounding pulse. Aconite has been called the «vegetable lancet» since it dilates the blood-vessels so, bleeding one into one's own veins, as it were. In poisonous doses it causes nausea, vomiting, cold, clammy skin, very slow weak pulse and breathing, and finally paralysis of the heart and respiration, and death. Death has taken place in from one to five hours from the root. Doses above 3 milligrams (1-20 gr.) a day are dangerous; 1-200 gr. is a safe initial dose. Treatment is symptomatic, special attention being paid to the respiration by artificial means, and heart stimulants,— strychnine, etc.

Acontius, in a Greek legend retold by Ovid in his ‹Heroides,› a youth of the island of Cea, who went to Delos to see the sacred rites performed by a crowd of virgins in the temple of Diana, and fell in love with Cydippe, a beautiful virgin. Not daring to ask her in marriage on account of the meanness of his birth, he presented her with an apple on which were inscribed these words: «I swear by Diana, Acontius shall be my husband.» Cydippe read the words, and, feeling herself compelled by the oath she had inadvertently taken, married Acontius. William Morris has used the story in the ‹Earthly Paradise.›

Acorn-shell, a barnacle of the family Balanidæ. See BARNACLE.

Acorus. See FLAG, SWEET.

Acosta, Gabriel, ä-kōs-ta, Portuguese philosopher: b. Oporto 1591; d. April 1640. Of a converted Jewish family, educated a Roman Catholic, his studies led him back to Judaism, and he fled with his mother and brothers to Amsterdam. He again developed heretical opinions, was taken to task by the synagogue, and excommunicated; his writings were confis-

cated and himself fined; and years of persecution by the Jewish authorities and his family drove him to suicide. Gutzkow made him the hero of his novel 'Die Sadducäer von Amsterdam' (1834), and of his tragedy 'Uriel Acosta' (1846). The work which caused Acosta's excommunication was 'Examen Traditionum Pharisæicarum Collatarum cum Lege Scripta' (1623, in Latin).

Acosta, Joaquin, ä-kōs'ta, hooä-kēn', South American soldier and geographer: b. Guachias, Colombia, 29 Dec. 1799; d. there 1852. He was an officer of engineers in the Colombian army, member of the New Grenada Convention 1831, later representative in its Congress. In 1834 he explored the Socorro valley to the Magdalena with the botanist Cespedes, and in 1841 traveled from Antioquia to Aserma to study the various Indian tribes. For a time he was minister from New Grenada to Ecuador; was *chargé d'affaires* at Washington 20 July to 8 Nov. 1842; and later secretary of state in New Grenada. He published at Paris in 1848 a history of the discovery and settlement of New Grenada, with a valuable map of his own drawing, the first made since the independence of Colombia; and in 1849, at Paris, a 'Miscellany of New-Grenadan Sciences, Literature, Arts, and Industries,' with portraits and map.

Acosta, José, ä-kōs'ta, hō-sā', Jesuit and historian: b. Spain, c. 1540; d. rector of Salamanca in 1600. In 1571 he went to Peru, where he spent 15 years, becoming provincial of his order. After two years in Mexico and the West Indies he returned to Spain laden with manuscripts and information, and became a royal favorite. His theological works evinced great learning, but it is by his 'Natural and Moral History of the Indies' that he is best known. The complete work was published at Seville in 1590 and proved the most popular and most satisfactory account of the New World up to that time. An English translation appeared at London in 1604, a reprint of which was issued by the Hakluyt Society in 1880.

Acouchi, or **Acouchy.** See AGUTI.

Acoumeter («hearing-measurer»), an instrument to determine the acuteness of hearing. It is a small steel bar of uniform pitch, to be struck with a hammer or falling weight with gradations of force.

Acoustics (from ἀκούειν, to hear) is the science of the production, propagation, and audition of sound. The term sound is sometimes by definition restricted to the sensation involved in hearing, but is never consistently so used. Both by derivation and by common and best usage it should be applied to those aërial or other vibrations which, were they to reach the ear, would produce audition. The term being thus used, sound consists of waves of longitudinal vibration, that is to say of waves of to and fro motion perpendicular to the wave front. Such motion, propagated through an elastic medium with a finite velocity, results in alternate rarefaction and condensation.

A moment's consideration of any source of sound will show it to be of such a nature as to give either a single impulsive blow or repeated blows, usually systematically repeated, to the surrounding medium. In the great majority of cases, and those the more interesting both theoretically and practically, the source of sound consists of an elastic body distorted from its normal shape, and, released, vibrating more or less symmetrically about this normal shape or position. It results from this vibratory motion that a series of impulses is given to the surrounding medium which are periodic, nearly similar in character, and nearly equally timed. These impulses, propagated through the surrounding medium all with the same velocity, follow each other in the form of a train of waves. The distance from a point in one impulse to the corresponding point in the next impulse is called the wave length of the sound. The frequency of these waves as they strike the ear determines the pitch of the sound; the character of the wave in respect to form determines the quality of the sound; while both of these together with the amplitude of vibration and the density of the medium determine the loudness or strength of the sensation.

In respect to pitch sounds audible to the human ear range in frequency from about 24 vibrations per second to 40,000 vibrations. Sounds very much higher in pitch are audible to some animals, the cat for example, while for some animals it is probable that the upper limit is not so high, although in regard to the latter point no reliable data have been secured, the interest of the biologists apparently being to extend the range. In regard to the lower limit in other auditors than man no reliable experiments have been made, and if attempted would be extremely difficult because of the difficulty of distinguishing the reactions due to the mechanical disturbance from the reaction due to true audition,— a difficulty which indeed affects all such experiments, but which is enhanced in the case of the lower limit.

The quality of a sound is determined by the wave form. A pure musical tone is due to simple harmonic motion, a type of periodic motion best described as the projection on a diameter of uniform circular motion, and most familiarly illustrated by the motion of the pendulum of a clock. Perfectly pure tones are rare, the nearest approach being that of a tuning fork reenforced by a resonator. Most musical sounds are far from being pure tones. They may, however, be regarded as a complex of a number of pure tones, each pure tone being then called a partial tone. Of these partial tones the lowest, which is generally though not always predominant, is called the first partial, and the other partial tones in order of their pitch are called the second, third, etc., partials. In many of the more interesting cases such as the tones of the organ pipe, or of a bowed, struck or plucked string, the upper partials are harmonics of the fundamental. The pitch and the relative intensities of the partial tones determine what is called the quality of the sound, the pitch of the whole being usually rated as that of the lowest partial. When a sound is incapable of analysis into pure tones it is called a noise. In many, indeed it is safe to say that in most sounds that are classed as noise there is some trace of a predominant note, and of a definite musical pitch which a trained ear can detect.

The loudness of a sound is capable of being variously defined. If by the loudness of a sound is meant physical energy and if the sound is a pure tone then its loudness depends on the amplitude of vibration and the pitch, being pro-

portional to the square of each, and on the density of the medium, to which it is directly proportional. The loudness of a sound is ordinarily defined, however, by the intensity of the sensation which it is capable of producing. Thus defined loudness is a function not merely of the amplitude of vibration and the density of the medium, but of the pitch and the quality as well, and moreover it is a complicated function of each. It is an interesting fact that in man there is a definite sense of loudness which renders it possible to compare, in respect to the intensity of the sensations which they produce, sounds differing in pitch by the whole of the musical scale. Moreover, this sense of loudness is apparently physiological and not dependent on familiarity with the "balance" of any musical instrument, and is to a high degree of accuracy the same for different persons, independent of age, sex, or musical training.

Production of Sound.— The best example of the single impulse as a source of sound is an explosion in unconfined and therefore non-resonant space. The result is an approximately single wave. When, however, the explosion occurs in a resonant cavity the result is a note of definite pitch determined by the cavity. Or a single explosion and impulsive wave may result in a train of waves and therefore a sound of definite pitch, by being reflected from uniformly spaced surfaces, such for example as the pickets of a fence. The next simplest source of sound is a siren, long a laboratory instrument, more recently made familiar by use in fog signals and steam whistles. The siren consists of two circular discs, the one fixed, the other pivoted to revolve nearly in contact with it. Both discs are pierced by a circle or by circles of holes through which steam or compressed air escapes as the holes in the two discs come opposite each other.

A straight bar of metal or wood may vibrate either transversely or longitudinally. If distorted transversely it vibrates to and fro through its normal straight form. The simplest form of this transverse vibration is that in which the bar at points one quarter the total length from either end remains at rest. These points of rest are called nodes and the intermediate part of free vibration is called an antinode. When vibrating in this manner the bar emits its fundamental note, the lowest note of which it is capable if entirely free. The next simple mode of vibration is that in which there are three nodes, or points of rest, at points one sixth the total length from either end and in the middle. In this case the bar emits a note having twice the frequency of the fundamental and in pitch an octave above it. Continuing in this way a series of simple types of motion may be determined. The notes thus produced have twice, three times, four times, etc., the vibration frequency of the fundamental. Any transverse free vibration of the bar is a combination of these forms, and the sound which it emits is a combination of these notes. In this manner the quality of the sound is determined. If the bar is clamped at one end the lowest note which it emits is an octave lower than the lowest when entirely free; and the higher tones, instead of being two, three, etc., multiples of the fundamental, skip every other one, being three, five, seven, etc., multiples of the fundamental. Touching the bar at any point tends to produce a node at that point and to strengthen the corresponding partial tone, and to diminish the partial tones having antinodes at that point. The exact converse is true in regard to striking the rod. Finally, the frequency of the several notes is proportional inversely to the length, and to the square root of the density, and directly to the square root of the rigidity, other dimensions being the same in each case.

When the rod is rubbed or stroked so as to vibrate longitudinally, either free or clamped at one end, its fundamental and overtones form the same systems as before, but all are of a different pitch, determined now by the length, density and modulus of elasticity. Thus the longitudinal vibrations of the free rod have as vibration frequencies of its overtones, all integral multiples of the fundamental. If the same rod is rigidly clamped at one end, its fundamental is an octave lower than the fundamental of the free rod, and the even integral overtones are absent.

A stretched string or wire, so small in diameter in comparison with its length that its rigidity is insignificant in comparison with its tension, vibrates for its fundamental over its whole length with nodes at each end. The first overtone is an octave above this in pitch, the wire vibrating with a node at the centre. The second overtone (third partial) is three times the fundamental in pitch frequency, the wire vibrating with nodes a third of the whole length of the wire from either end. The third overtone (fourth partial) is four times the fundamental in pitch frequency, with nodes at the quarter and middle points. A string set in vibration by any ordinary method vibrates in a more or less complex manner, emitting a sound containing the fundamental and overtones. The overtones present and their relative intensities are determined by whether the string is plucked, struck or bowed, and also by the point of application. The fundamental note emitted by a string is of a vibration frequency equal to the square root of the tension divided by the mass per centimeter of length, divided by twice the length.

If the vibrating elastic solid is in the form of a plate the system of overtones bears a complicated relationship to the fundamental, no longer being integer multiples in vibration frequency. The manner in which the plate vibrates may be shown by sprinkling sand on the plate, the latter being horizontal. When the plate vibrates the sand dances away from the parts of the plate in motion and settles in ridges along the nodes. When the plate is square and emitting its lowest tone the nodal lines traced by the sand form a cross reaching from the centres of the sides. By bowing the plate at different points the plate may be made to vibrate in very complicated forms. The sand figures thus traced often making attractive designs. The production of these various patterns is much guided by touching the plate at various points on the edge with the fingers, thus determining the ends of nodal lines. This experiment was first performed by Chladni, and the sand figures are called after their inventor Chladni's figures. Similar experiments can be carried out on stretched membranes, and one may investigate in this way the vibration of drum heads. The result of such an experiment shows that the quality of sound from a

drum depends on the point at which it is struck, and that the upper partials are inharmonics of the fundamental.

Next to the stretched string the most interesting case of a vibrating body is that of a column of air. To a first approximation the problem of the vibration of an air column is as simple as that of a stretched string, but in its practical forms and more accurate solution it is by no means so simple. The vibration of a column of air, according to the theory advanced by Bernoulli, is identical with the longitudinal vibration of a straight bar of metal. If the column of air is in a tube open at both ends, the simplest form of vibration and that in which it emits the lowest possible note is such that the air moves to and fro at both ends having a node at the middle. The first overtone, having a vibration frequency twice that of the fundamental, is produced by the column of air vibrating freely at both ends, vibrating freely at the middle, and having nodes at points one quarter of the total length of the pipe from either end. The second overtone has three times, the third overtone four times, etc., the vibration frequency of the fundamental. If the column of air is closed at one end the lowest tone which it can emit is an octave below the lowest tone emitted by the same pipe open at both ends. The overtones in this case are three, five, seven, etc., times the fundamental in frequency. The analogy of this with the bar of metal is obvious. It might be added that according to Bernoulli's theory the note emitted by the column of air is such that the sound could travel from the open end to the first node during one quarter of a vibration. This, only approximately true in the case of the column of air, is very strictly true in the case of the metal rod. It follows from this that the pitch of the note emitted by a column of air can be varied either by varying the length of the column, the pitch being inversely proportional to the length, or by so exciting the air that it vibrates according to the higher forms with nodes nearer the ends. The application of this to musical instruments is very simple. Take, for example, organ pipes of what are called flue stops as distinguished from reed stops. All such organ pipes are, obviously, open at the end at which they are blown. According as they are open or closed at the other end they are called open or closed pipes. Open pipes have nodes at their middle when sounding the fundamental note, while the closed pipes have their nodes at the closed end. A closed pipe is therefore an octave lower in pitch than an open pipe of the same length, accurately according to the theory of Bernoulli, but as a matter of fact only approximately so. In a pipe organ the variation in pitch is accomplished not merely by using open and closed pipes, but principally by using pipes of different lengths. The pipes not uncommonly vary in length from thirty-two feet to half an inch. In the military trumpet we have an exceedingly simple instrument whose whole available scale consists in the overtones, the particular note being determined by lip tension and wind pressure. In the slide trombone the scale is produced not merely as in the trumpet, but by varying the length by means of the slide. In the cornet the variation in length is accomplished by means of keys turning valves which throw into the length of the pipe or cut out from it short auxiliary convolutions. In the French horn the scale is played not merely by the means adopted in the cornet, but by means of the hand thrust into the bell or flared end, thus partially closing it and so lowering the pitch. In the flute, clarionet, and wood wind-instruments generally the variation in pitch is accomplished by opening and closing ports on the side of the tube.

A little more might be said in regard to stringed instruments. The strings are, in general, so narrow that when vibrating they cut through the air, communicating, practically, no motion to the air and therefore emitting, practically, no sound directly. The sound which we hear therefore comes not from the string, but from the sounding boards with which they are always placed in contact. It is thus because the sound which we hear comes from the body of the violin and scarcely at all from the strings directly that its quality depends so much more on the instrument than on the strings with which it is stretched.

Propagation of Sound.— When a sound is produced in free air at a distance from all obstacles it spreads in spherical waves, diminishing as it spreads over greater and greater surfaces, the intensity of the sound diminishing as the wave increases. The area of a sphere being proportional to the square of the radius we have the so-called law of the inverse square of the distance. The velocity of propagation of a sound through a medium is independent of the pitch of the sound or of its loudness and depends only on the nature of the medium — its elasticity and its density. In any medium the velocity of the sound is proportional directly to the square root of the elasticity and inversely to the square root of the density of the medium. Since the waves follow each other with so great rapidity that the air does not have time to cool during compression, the elasticity here referred to is that of adiabatic compression. A table is here given of the velocity of sound in various media.

Carbonic acid gas	866
Air	1,092
Hydrogen	4,190
Water	4,730
Pine wood	10,900
Copper	12,200
Iron	15,700

In this table the velocities given are in feet per second and at 0° C. A variation in temperature produces a variation in the velocity, particularly in the case of gases. A rise in temperature results in an increase of velocity, the increase being about .18 per cent for every degree Centigrade for all gases. This amounts to a little less than two feet per second in the case of air.

When the source of sound is coming toward the observer, the observer being stationary, the sound as heard is of a higher pitch than if the source were stationary, for the number of waves reaching the observer per second is increased in the ratio of the velocity of sound plus the velocity of the source to the velocity of sound. Similarly when the source is receding from the observer the sound received is of lower pitch. The change is strikingly observed as a bicycle bell or a clanging street car gong passes close by an observer. In

this case the fall in pitch is abrupt and marked. Similar phenomena are produced as the observer approaches or recedes from a stationary source. This is called Doppler's principle.

When the sound instead of being produced in uniform and stationary air is produced in air moving with various velocities the phenomena are much complicated. These phenomena were first studied with care in connection with fog signals by Henry, Tyndall, and Stokes. It was an old observation that fog signals plainly audible at a very great distance could often not be heard at a little less distance, still nearer were audible again, still nearer inaudible,— that these regions of silence and audibility varied, not merely on different days, but rapidly in the most mysterious and disconcerting manner, so much so as to receive the name of "sound ghosts." The explanation, for a long time sought in vain, was ultimately given in a suggestion by Stokes that they were due to a variability in the velocity of the wind in different strata of the atmosphere. The result of such an irregularity would be that the spreading sound waves instead of remaining spherical would be distorted very considerably. For example, the waves would be tipped back if the wind were greater at the higher altitude and against the sound. In such case the sound would rise from the water and there would be a region close to the surface over which the fog signal would be inaudible. If, on the other hand, the wind retarded the sound less above than below, or if the wind above favored the sound the wave would be tipped forward and the sound would descend upon the sea and there would be a resulting area of audibility. As the wind at different altitudes varies greatly and changes abruptly we have an entirely adequate explanation of the phenomena.

If the medium through which the sound is being propagated is not homogeneous another very interesting series of phenomena will occur. Whether the variation in homogeneity results from the variation in composition or a variation in temperature, the effect is the same. A change in either temperature or composition results in general in a change in the velocity of the sound. Whenever sound passes from one medium to another or from one region to another in which the velocity is different the direction of the sound is changed. It is said to be refracted. The law of refraction is a very simple one,— that the ratio of the sines of the angles made by the direction of propagation of the sound in the two media with a normal to the surface separating the media is equal to the ratio of the velocities in the two media. The sound is thus always bent toward the normal in passing from a medium in which the velocity is greater to a medium in which it is less. According to this principle the so-called acoustical lenses have been made. This may be done by filling a large but thin walled spherical balloon with some heavy gas. Such a lens properly placed will focus the sound of the ticking of a watch so that it can be heard at a distance considerably greater than that at which it can ordinarily be heard. When the lens is thus made with heavy gas it is a converging lens; when made with light gas it is a diverging lens. A curious but unintentional example of the latter occurred in the House of Parliament when a shaft of warm air, rising through the large ventilator in the middle of the floor, so diverted the sound that a speaker on one side could not be heard clearly by a member immediately opposite him.

Whenever a sound traveling through one medium comes to another medium in which its velocity is different a certain portion is reflected, the amount reflected depending upon the change in velocity of the sound and upon the angle at which it strikes the surface of separation. This furnishes the explanation of the so-called aërial echoes observed by Tyndall, and a partial explanation of the rolling of thunder.

When the reflecting surface is a solid wall a very large per cent of the sound is reflected, how much, depends, of course, on the nature of the wall. Under these circumstances there are produced a large number of important phenomena which are most strikingly interesting in connection with architectural acoustics. Under special but usually accidental conditions very peculiar phenomena arise as is illustrated in the case of whispering galleries. Whispering galleries are of one or the other of two general types usually illustrated, following the lead of Herschel, by the dome in Saint Paul's Cathedral, London, and by a much less familiar building, the cathedral in Girgenti. In Saint Paul's Cathedral if a person takes a position at one side of the dome and very close to the wall he can whisper with great ease and distinctness to a person at the opposite side of the dome. This is not the case of focusing sound in the ordinary sense. The sound starting from one point is carried by the curved surface along great circles on the interior of the almost spherical dome. The sounds traveling by all these paths meet again at the opposite end of the diameter. As distinguished from this the whispering gallery in the cathedral at Girgenti is produced by a single, isolated, but focused reflection. A better and more familiar illustration of this was until recently to be found in the Hall of Statues in the capitol at Washington. It is a necessary condition for both types of whispering galleries that the wall surfaces should be smooth and free from great projections. The whispering gallery in the Capitol at Washington has recently been destroyed by replacing the formerly smooth spherical ceiling by a rather deeply coffered ceiling in plaster. The ideal whispering gallery, should one be planned, would be secured by constructing a room a considerable portion of whose wall surface would be part of an ellipsoid of revolution with foci at the points between which the whispering is to occur. Another interesting and somewhat related phenomenon is that of multiple reflections. An interesting example of this recently occurred in a private athletic court at Rhinebeck-on-the-Hudson. In this case the ceiling was a smooth dome so nearly flat that its centre of curvature was at a distance below the floor equal to the height of the room. Here the echo was repeated very many times and the sound was reflected three times between each repetition of the echo. Such special forms of walls not infrequently occur in auditoriums, often in a subtly concealed manner, and are the occasion of much annoyance. It might be added that it would not be a safe generalization to say that all curved surfaces are bad or that all disturbing surfaces are curved.

In the absence of specially disturbing surfaces the multiple reflection of the sound results in a general reverberation, which is from some points of view advantageous and from some harmful. The reverberation results in an increased loudness particularly of sustained tone. On the other hand by the prolongation of each sound it results in more or less confusion. When the room is to be used for musical purposes, the effect of this reverberation, unless it be carried to too great an extent, is to blend the tones and to give to the performer a sense of support from the auditorium. There is apparently a nice balance which for the best musical effects must be accurately attained in order to fully satisfy expert musical taste. The reverberation in the room as well as the general loudness and even the loudness at the several points can be calculated when the dimensions of the room and the absorbing power of its various surfaces are known.

Another feature of architectural acoustics is the phenomenon of interference. Taking first the simplest possible case when a sound from a distant source strikes normally on a plane wall, the reflected waves meeting the following on-coming waves produce by their superposition a system of stationary waves parallel to the reflecting surface. The result would be great nodal and antinodal surfaces parallel to the reflecting wall. An observer moving about in such a medium would hear the sound as very loud at the nodal surfaces. When the sound is produced in a confined space, such as a room, it is reflected from wall to wall many times and in many directions before it is ultimately absorbed. The result is an exceedingly complicated system of stationary waves. Under certain conditions the sound may be so intense at certain points of the room as to be unendurable, while at other points but a few feet distant it is so faint as to be scarcely audible. The distribution of such a system of stationary waves depends on the shape of the room, the material of the walls, and the position of the source of sound. It also depends on the pitch of the sounds.

When the conditions of the room are such that a system of stationary waves are so formed that a region of great intensity coincides with the source, the phenomenon of resonance occurs. That is to say the emission of that particular note will be increased in comparison with other notes of such pitch that their greatest nodal intensity in their own interference systems do not coincide with the source. This phenomenon is called resonance. Both interference and resonance result in the destruction of chordal balance.

Audition.— The ear is ordinarily divided, in anatomical work, into three parts, the outer, the middle and the inner ear. The drum of the ear separates the outer from the middle ear, the middle ear being an air cavity connected by the eustachian tube with the nasal cavity. The sound is conducted across the middle ear by a system of three bones which connect the drum with another membrane separating the middle ear from the inner ear. The inner ear is a somewhat complicated cavity in the solid bone of the skull. It consists essentially of three semicircular canals, and a much longer and larger snail-shell-like cavity called the cochlea. This inner ear is separated from the middle ear not merely by the membrane already referred to pressed against and vibrated by the bones, but also by another small membrane. Starting from between these two membranes a diaphragm runs the length of the cochlea. This diaphragm somewhat intricate in its complete structure, has as an essential part a system of numerous stretched fibres, varying in length and probably also in tension. When the sound is conducted from the outer ear to the inner ear by the three bones in the middle ear, the vibration is communicated to a liquid which fills the inner ear. This liquid in vibrating causes the small fibres of the diaphragm, called the fibres of Corti, to vibrate. As the fibres of Corti are of different lengths and of a different tension, different regions of the diaphragm respond to different notes. On this diaphragm terminate the auditory nerves which are stimulated by the vibration of the fibres, and communicate the corresponding sensation to the brain. The variation in pitch sensation is due to variation in the stimulated region of the diaphragm. When the sound is not a pure tone the various partial tones excite the corresponding parts of the diaphragm. When two notes are sounded, each with its system of overtones, there are regions of the diaphragm more or less excited simultaneously by the two systems. When the two partials which excite overlapping regions of the diaphragm are not of exactly the same pitch beats occur between them. These beats when slow are not wholly disagreeable, and having a tremulo effect in moderate use are not without musical value. When, however, the beats are more rapid, and this occurs when the overlapping partial tones differ more in pitch, the beats lose their distinct character as such and produce the effect known as discord. If the two partial tones differ still more in pitch the regions which they excite overlap less and less and the discord diminishes. Following out this line of argument Helmholtz was able to show that when the fundamentals having harmonic upper partials bear to each other simple ratios in their vibration frequency their discord is a minimum, deriving in this way a complete explanation of the musical scale as used in harmonic composition. The scale thus obtained is the true or natural scale. The intervals between the successive notes are not equal, but fall into two groups of so-called whole and half tone intervals. The whole tone intervals are not equal among themselves and are not twice the half tone intervals. Therefore, even after inserting sharps and flats to sub-divide the whole tone intervals the resulting chromatic scale is not one of equal interval. While this is the scale which would be employed by instruments without fixed key-boards, and by the human voice accurately trained, it cannot be employed in instruments with fixed key-boards if such instruments are to be used in different keys.

For this purpose Bach invented a scale called the equally tempered scale in which all the half tone intervals are made equal. On this scale no key is accurate, but no key is so inaccurate as to result in serious discord. The following table gives the vibration frequency of the eight notes of the middle octave on the natural and on the tempered scale:

	Natural Scale.	Tempered Scale.
C	258.7	258.7
D	291.0	290.3
E	323.4	325.9
F	344.9	345.3
G	388.0	387.6
A	431.1	435.0
B	485.0	488.2
C	517.3	517.3

As the invention of the musical scale long preceded its use in harmonic composition, and during the period preceding the 11th century was used only in melodic composition — that is for notes sounded in sequence — the simultaneity necessary for harmonic effect was obtained by the prolongation of one note into the other. This probably resulted from reverberation due to architectural conditions.

Wallace Clement Sabine,
Professor of Physics, Harvard University.

Acquaviva, Andrea Matteo, än'drā-a mät'-ā-ō äk'wa-vē'va, Duke of Atri and Prince of Teramo, in the kingdom of Naples: b. 1456; d. 1528. He seems to have been the first who conceived the idea of an 'Encyclopædia,' or 'Universal Dictionary of Arts and Sciences.' He published a useful work under that title in two folio volumes.

Acqui, äk'wē, N. Italy. (1) A district in the province of Alessandria, on the N. side of the Ligurian Apennines. Area, 445 sq. m. Productions, corn and fruit. Chestnut-trees furnish the peasantry with an article of common food, and silkworms are reared. (2) Its capital and episcopal city, on the Bormida, 18 m. S.S.W. of Alessandria, 37 m. N.W. of Genoa. It has commodious hot sulphur baths, and is celebrated for its great antiquity and for the remains of a Roman aqueduct. The hot sulphur baths were known to the Romans, who called the place *Aquæ Statiellæ.* There is an extensive trade in wine, silk, lace, and rope. Acqui has a cathedral, a royal college, and is a bishop's see. It was taken by the Spaniards in 1745; retaken by the Piedmontese; and afterward dismantled by the French. Pop. (1901) 13,786.

Acquisition is the act by which a person procures property in a thing; also the thing the property in which is secured. Original acquisition is that by which a man secures a property in a thing which is not at the time he acquires it, and in its then existing condition, the property of any other individual. It may result from occupancy, accession, or intellectual labor.

Acquittal, in law, the judicial setting free or releasing a person from a contract, debt, or other obligation; but the term is more commonly used in criminal law to signify the deliverance from a charge of an offense, either by a verdict of not guilty by a jury, or by simple operation of law, as in the case of an accessory where the principal is acquitted. In the United States acquittal may be the result of some technical defect in the proceedings or by the verdict in favor of the accused on the merits of the case. In the first case a second trial of the case may be instituted, but the second case is a bar to any further prosecution of the accused for the same offense. This is guaranteed by a Constitutional provision that "no person shall be twice put in jeopardy for the same offense."

Acræinæ, a sub-family of butterflies of the family *Nymphalidæ,* deriving its name from the leading genus *Acræa.* There are about 85 species, mostly African. They are of small or moderate size, and have semi-transparent wings, reddish-brown marked with black.

Acra'nia, a primary division of *Vertebrata,* represented by *Amphioxus* (q.v.) in which, as the name indicates, there is no skull, while the notochord extends to the anterior end of the snout, in advance of the central nervous system. There is no true brain, the region corresponding to the brain of the genuine vertebrates being very imperfectly differentiated. There are only two pairs of cerebral nerves, and the dorsal and ventral spinal nerves do not unite. There is also no trace of limbs. The pharynx is of comparatively immense size, perforated by very numerous gill-slits, and surrounded by an atrium. The liver is a hollow pouch of the intestine. There is no heart, and the blood is colorless. The numerous nephridia remain distinct and open into the atrium. There are no paired eyes, only a single median pigment-spot in the wall of the brain; there are no ears, though an olfactory pit is present. The reproduction glands are segmentally arranged, but have no ducts.

Acrasia (Gr. ἀκρασία, intemperance), a beautiful woman, the personification of all that is intemperate and immoderate, portrayed in Spenser's 'Færie Queene.' She lives in a "Bower of Bliss," on a floating island, in which there is everything to delight the senses. Her character was suggested by Circe, but probably more directly by the Alcina of Ariosto.

Acre, Syria (Biblical *Accho,* Greek *Ptolemais,* other forms *Acco, Akka, Acon, Accaron;* modern French St. Jean d'Acre), a port some miles north of Mt. Carmel, on the Bay of Acre, opposite Haifa on the opposite horn. The harbor is one of the best on the coast; even so, it is much choked with sand. Its interest is chiefly in its varied and picturesque past: as the chief landing place for invasion of Syria, it has perhaps suffered more from political revolutions and war ravages than any other place in history. Its name first occurs in a letter of King Burnaburiash of Babylon to Amenhotep IV. of Egypt, c. 1400 B.C. Sennacherib of Assyria captured it 701 B.C., and his son Esarhaddon about 675 gave it to the king of Tyre. After the break-up of Alexander's empire, Ptolemy Soter of Egypt took possession of it and renamed it Ptolemais; it afterward became part of the Seleucid empire of Syria; and later the Romans acquired it and made a colony of it. Under the early empire it was a city of great importance, and remnants of its grandeur in the shape of fine granite and marble pillars still exist. In 635 A.D. the Saracens under Khaled and Obeida captured it and Damascus. They were expelled from it in 1110 by the Crusaders, who made it their principal port and retained it till 1187, when it was recovered by Saladin. Four years later it was retaken by Richard Cœur de Lion and Philip II. of France, at the cost of 100,000 lives. They made it a bishopric and gave it to the order of St. John (Fr. St. Jean, from which it took its French title). These held it for just a century, despite continual assaults from the Saracens; and it

was a large, rich, and powerful city, filled with churches, convents, and hospitals. In 1291, when it had become the last Christian stronghold left in Syria, the Saracens retook it after a bloody siege which injured it greatly. From that time it sank rapidly. In 1517 it fell into the hands of the Turks under Selim I.; and at the beginning of the 18th century it was a vast scene of ruin, relieved only by a few cottages, a mosque, and the houses of French factors. Toward the end of that century the Turks, especially Djezzar, much strengthened and improved it, and it rose to some importance again. It is best known in modern times for its brave and successful defense in 1799, by means of a body of English soldiers and marines under command of Sir Sydney Smith, against Napoleon, who, after spending 61 days before it, was obliged to retreat. It continued to prosper and be the seat of a considerable trade till 1832, with consuls from all the great states, though crippled by the imposts, monopolies, and misgovernment with which the Turks blight every place that endures them. On the revolt of Mehemet Ali, the great Viceroy of Egypt, his son Ibrahim besieged it for 5 months and 21 days in the winter of 1831–2, and before he captured it, its public and private buildings were mostly destroyed. The Egyptians repaired and improved its fortifications; but on 3 Nov. 1840 a 3-hours bombardment by a combined English, Austrian, and Turkish fleet reduced it to a ruin. The Turks were again put in possession of it in 1841.

Acre, originally «field,» «pasture,» «hunting-ground»; but later a rough measure of size, somewhat similar in different countries, and supposed to represent what one man could plow in a day. The Italian term *giornate* (day's work) is significant on this point. In England reckoned as the amount a yoke of oxen could plow in a day, till the laws of the 13th century and later settled a definitive measure. There and in the United States this is termed the *statute acre,* old customary acres being still used in Scotland, Ireland, and Wales, as well as in several English counties, all different and some of them less than half the statute, while others are more than double. The statute acre is 43,560 square feet, or 4,840 square yards, or 160 square rods or perches (from the yard and the rod or pole with which it was measured); also divided into 4 roods, though this and perch are mere book-words in the United States at least, as is the square «chain» of 22 yards or 484 square yards, from the surveyor's chain used in measuring it. The following table gives various measures in relation to the English and American acre. The German empire having adopted the French metrical system, the German *morgen* are becoming of historical significance merely.

English	acre	1.00
Cheshire	"	2.11
Westmoreland	"	1.40
Lincolnshire	"	1.25
Cornwall	"	1.19
Leicestershire	"	0.48
Scotch	"	1.27
Irish	"	1.62
Welsh	erw	0.89
	stang	0.67
Austria	joch	1.42
Baden	morgen	0.89
Belgium	hectare (Fr.)	2.47
Denmark	toende	5.50
France	hectare (100 ares)	2.47
	arpent (common)	0.99
Hamburg	morgen	2.38
Hanover	"	0.64
Holland	"	2.10
Naples	moggia	0.83
Poland	morgen	0.83
Portugal	geira	1.43
Prussia	little morgen	0.63
	great morgen	1.40
Russia	deciatina	2.70
Sardinia	giornate	0.93
Saxony	morgen	1.36
Spain	fanegada	1.06
Sweden	tunneland	1.13
Switzerland	faux	1.62
Geneva	arpent	1.27
Tuscany	saccata	1.22
United States	acre	1.00
Wurtemberg	morgen	2.40
Roman, ancient	jugerum	0.66
Greek, ancient	plethron	0.23

NUMBER OF PLANTS FOR AN ACRE OF GROUND.

Dist. apart.			Number of plants.
Inches.			
3	by	3	696,960
4	by	4	392,040
6	by	6	174,240
9	by	9	77,440
Feet.			
1	by	1	43,560
1½	by	1½	19,360
2	by	1	21,780
2	by	2	10,890
2½	by	2½	6,960
3	by	1	14,520
3	by	2	7,260
3	by	3	4,840
3½	by	3½	3,555
4	by	1	10,890
4	by	2	5,445
4	by	3	3,630
4	by	4	2,722
4½	by	4½	2,151
5	by	1	8,712
5	by	2	4,356
5	by	3	2,904
5	by	4	2,178
5	by	5	1,742
5½	by	5½	1,417
6	by	6	1,210
6½	by	6½	1,031
7	by	7	881
8	by	8	680
9	by	9	537
10	by	10	435
11	by	11	360
12	by	12	302
13	by	13	257
14	by	14	222
15	by	15	193
16	by	16	170
16½	by	16½	160
17	by	17	150
18	by	18	134
19	by	19	120
20	by	20	108
25	by	25	69
30	by	30	48
33	by	33	40
40	by	40	27
50	by	50	17
60	by	60	12
66	by	66	10

Acré River, ä'krā, South America (also called **Aquiry,** ä'kē-rē), a tributary of the Purus River. Its sources have not yet been precisely located, but are probably on the eastern Andean slopes near lat. 11° S. From the point at which it becomes navigable for small steamers its course is generally northeast to its confluence with the Purus; the latter flows nearly parallel to and north of the Madeira, emptying into the Amazon west of Manáos. Together these rivers give access to an exceedingly valuable rubber forest district, long in dispute between Bolivia, Peru, and Brazil. The name Acré is commonly applied to the entire region. Bolivia, claiming that her sovereignty had been recognized by Brazil in the treaty of 1867 and by subsequent acts, granted a conces-

sion for developing the rubber products to an Anglo-American syndicate in 1902; but she was not allowed to live up to this agreement, though she had troops and a military governor on the ground. The Brazilian inhabitants rose, imprisoned or drove out every Bolivian in the district, captured Port Acré 24 Jan. 1903, installed a new governor, and proclaimed their allegiance to Brazil. The latter country thereupon sent an ultimatum to Bolivia, and on 8 February the Bolivian government agreed to admit Brazilian occupation pending a settlement. The treaty between Bolivia and Brazil signed 17 Nov. 1903 provides for the relinquishment by the former country of all that part of the vast Acré region lying north of the Abunan, in lat. 10° 20′ S., and a line following water courses in a southwesterly direction from that point to lat. 11° S., or approximately to the sources of Acré River. Brazil agrees to pay "an indemnity of £2,000,000 sterling, which the Republic of Bolivia accepts with the intention of using the same mainly in the construction of railways or other works tending to improve the communications and develop commerce between the two countries" (Art. 3). Moreover, Brazil (in Art. 7) "binds herself to build on Brazilian territory, by herself or by a private company, a railway to extend from Santo Antonio on the Madeira River to Guajará-Mirim on the Mamoré, with a branch road running through Villa-Murtinho, or another point near it in the State of Matto Grosso, to Villa Bella at the confluence of the Beni and Mamoré," the object being to furnish an outlet to the Madeira and Amazon for Bolivian products (see SOUTH AMERICA); and in Art. 8 Brazil "declares that she will negotiate directly with the Republic of Peru the boundary dispute concerning the territory comprised between the source of the Javary (or Yavari: about lat. 7° S.) and parallel 11°, and will endeavor to reach a friendly solution of the litigation." Bolivia and Peru agreed by treaty of 21 Nov. 1901 to submit to arbitration all controversies pending between them; their long-standing boundary disputes were actually referred to the President of the Argentine Republic as arbitrator in 1904. There still remained to be determined the conflicting claims of Peru and Brazil to that portion of the great Amazon basin comprised between lat. 7° S. and lat. 11° S.; extending from the eastern cordillera of the Andes to the heart of the continent; watered not only by the Acré but by the Juruá and Purus rivers as well; a country imperial in size and of incalculable undeveloped resources, yet so situated that it is wholly dependent upon Brazil. An examination of the maps (see SOUTH AMERICA) will show that the lands in question are valueless unless Brazil keeps open the only outlets for their produce, the waterways through Brazilian territory to the Atlantic; that, therefore, Peru cannot reasonably hope to gain anything in this contention by force of arms if Brazil is unwilling to yield. Besides, a resort to arbitration was indicated as the proper course by the experience of Bolivia and Brazil. Nevertheless, when Brazil demanded the evacuation of points in the disputed territory occupied by Peru, as a condition precedent to arbitration, Peru refused compliance, saying that she, for her part, proposed arbitration "without demanding previous conditions which should be regarded as unnecessary by governments really wishing to reach a prompt, just, and pacific settlement of their differences" (May 1904). The delay proved fatal to Peruvian interests in this quarter. While diplomatic notes were being exchanged, Brazilian troops from Manáos defeated the small army of occupation maintained by Peru. Thus the Acré-Purus-Juruá region passed under Brazilian control.

Acres, Bob, an awkward young country booby of the gentleman class of England, who figures in Sheridan's comedy of 'The Rivals.'

Acrisius, in Greek mythology, king of Argos. He expelled his twin brother Prœtus (q.v.) from his inheritance and for a time ruled alone in Tiryns and Argos, but was later forced to surrender to his brother the former kingdom. He was the reputed founder of the Delphic amphictyomy. For the legend concerning the prediction of the oracle that he would die at the hands of his grandson, see PERSEUS.

Acrobat. See GYMNASTICS.

Acroceraunium, ak′rō-se-râ′nē-um, the N.W. promontory of Epirus, with mountains called Acroceraunia ("thunder-peaks"), which separated the Ionian and Adriatic Seas, and were noted for attracting storms, and hence dreaded by mariners. Its modern name is Chimara or Cape Glossa, or Cape Linguetta.

Acrocorinthus, in ancient times the acropolis or citadel of Corinth: a steep rock nearly 1,900 feet high, overhanging the city, and crowned with the remains of Venetian and Turkish fortifications, ruins of mosques and dwelling-houses, and also a barrack with a few soldiers. On its top stood of old a temple of Aphroditē.

Acrop′olis, the high part of any ancient Greek city; usually an eminence overlooking the city, and frequently its citadel. Notable among such citadels were the Acropoleis of Argos, of Messene, of Thebes, and of Corinth; but preeminently the Acropolis of Athens, to which the name is now chiefly applied. This was the original city (as indeed most of the acropoleis, dating from the times of barbaric insecurity), later the upper city as distinguished from the lower, and was built upon a separate spur or butte of Hymettus. The hill rises out of the plain, a mass of rock about 260 feet high, with precipitous sides save for a narrow access at the western end where there was a zigzag road for chariots. The summit of this rock forms an uneven plain 500 by 1,150 feet at the maximum breadth and length. Within this area were reared, chiefly in the days of Pericles, remarkable specimens of architectural art. The buildings were grouped around two principal temples, the Parthenon and the Erechtheum. Between these temples stood the statue of Athene Promachos («fighter in front»), by Phidias, the helmet and spear of which were the first objects visible from the sea. About these centre-pieces, covering the rocky height and extending down the steep sides, were lesser temples, statues, theatres, fanes, and odea (music halls). Among the famous buildings on the sides of the Acropolis were the Dionysiac theatre, the Odeum of Pericles, and the Odeum, built by Herodes Atticus in honor of his wife Regilla. The ravages of accident and war and Athenian marble-

merchants, and in case of the Parthenon (q.v.) its deliberate dismantling by Lord Elgin early in the 19th century, have largely destroyed and despoiled these classic works. Archæologists have secured many important remains of the Acropolis, which are preserved in the collections of various European capitals and in the new archæological museum at Athens.

Acros'tic, a poetical composition, disposed in such a manner that the initial letters of each line, taken in order, form a person's name or other complete word or words. This kind of poetical trifling was very popular with the French poets from the time of Francis I. until Louis XIV. Among other English writers, Sir John Davies, who lived in the 16th century, amused himself in this way. He produced 26 pieces called ‹ Hymns to Astrea,› each of them forming an acrostic upon the words Elisabetha Regina. The following is an example:

E ternal virgin, goddess true,
L et me presume to sing to you.
I ove, e'en great Jove, hath leisure
S ometimes to hear the vulgar crew,
A nd heed them oft with pleasure.

B lessed Astrea! I in part
E njoy the blessings you impart,
T he peace, the milk and honey,
H umanity and civil art,
A richer dow'r than money.

R ight glad am I that now I live,
E 'en in these days whereto you give
G reat happiness and glory;
I f after you I should be born,
N o doubt I should my birthday scorn,
A dmiring your sweet story.

In the Old Testament there are 12 psalms written according to this principle. Of these the 119th Psalm is the most remarkable; it consists of 22 stanzas, each of which commences with a Hebrew letter and is called by its name. Acrostic verse is no longer cultivated by serious poets, and has in fact been relegated mainly to country newspapers, except as a jest or social pastime. Edgar Allen Poe, however, wrote some striking acrostics, varying the form with great ingenuity. One example, beginning with the first letter of the first line, the second of the second, and so on, forms a lady's name.

Acroterion (« extremity »), in architecture, an ornament — statue, palmette, or leaf-decoration — placed on the apex of a pediment or one of its lower angles.

Act. *In the drama:* one of the parts into which a play is divided, to mark change of time or place, to give a respite to the actors and audience from the strain and physical fatigue of sitting intent on a long play, and to enable actors to change costumes and managers to change scenery. In Greek plays, where there was no scenery and no change of costume, there were no separate acts,— the episodes separated by the lyrical portions being not such either in design or effect,— and the action was continuous from beginning to end and the unities strictly observed. If the principal actors left the stage, the chorus took up the argument and contributed an integral part of the play; chiefly in the form of comment on the action, but often by supplying necessary information impossible to give in the regular speeches. When it was desired to develop the story further than the single play could conveniently do, another *drama*, — etymologically the same as *act*,— carried it on to another time or place, forming the common Greek trilogies, or groups of three, in which the same characters reappear. The Roman theatre first adopted the division into acts, suspending all stage business in the intervals. They made the regular number five, and Horace sets this down as a fixed rule of art. On the revival of letters it was almost universally used by dramatists; and that it rests on something more than caprice is shown by the fact that Shakespeare, who cared nothing for fixed rules of art and utterly disregarded the unities, never varies this division. For a great drama there is a real reason, though in light comedy it is almost universally dropped at present. The natural division is into three,— introduction, climax, and conclusion; and the central act still fulfills the same function. But for a great action this is apt to hurry matters too fast for a proper development either of character or interest; hence the first and the last act are doubled, the approach to the main point and the preparation for the catastrophe being both rendered more gradual. Some critics have laid down exact rules as to the part each act is to sustain in a play; but these cannot be justified and have never been regarded. It is obvious, however, that each act should form a certain unity, ending with a point of deep but suspended interest, yet should be an integral part of the whole. Molière began the three-act comedy; but even to an impatient generation this is too short for a play of power, and four is most preferred. See DRAMA.

In Law.— (1) Anything officially done by the court, as the phrases « Acts of Court,» « Acts of Sederunt,» etc. (2) In bankruptcy, an act the commission of which by a debtor renders him liable to be adjudged a bankrupt. (3) In civil law, a writing which states in a legal form that a thing has been said, done, or agreed. (4) In evidence, the act of one conspirator performed in pursuance of the common design may be given in evidence against his co-conspirators. (5) Acts done, distinguished into acts of God (q.v.), of the law, and of men.

In mental philosophy, an operation of the mind supposed to require the putting forth of energy, as distinguished from a state of mind in which the faculties remain passive. In this sense such expressions as the following are used: the act of thinking, the act of judging, the act of resolving, the act of reasoning or of reason; each of these being viewed as a single operation of the human mind.

In parliamentary language, an ellipsis for a law enacted by a congress, legislature, parliament, etc. A statute, law, or edict, consisting of a bill which has been successfully carried through both Houses of Congress or legislature, and received the approval of the executive. See specific titles *infra,* ACT OF GOD; ACT OF SETTLEMENT; ACT OF SUPREMACY; ACT OF TOLERATION; ACT OF UNIFORMITY.

In theology, the carrying out of an operation in a moment, as contradistinguished from the performance of a work requiring a considerable time for its accomplishment.

In universities, of old, the commencement or taking of degrees; now disused save as a form at Cambridge, England. The student « keeps the act » by reading a Latin thesis which he must defend against three opponents named by the proctors.

Acta Diurna («Daily Acts»); also called ACTA POPULI, «Acts of the People»; PUBLICA, «Public Acts»; URBANA, «Municipal Acts.» Written daily newspapers in ancient Rome, posted up in public to be read or copied, then taken down and filed in the public archives. The news was collected by reporters (*actuarii*) employed by the State, and consisted of much the same sort of matter as that contained in modern newspapers: a miscellany of everything that might interest the citizen, from the latest war news, abstracts of the best speeches in the Senate or Forum or the courts, the most important legal decisions or political events, probably even to interviews, down to the most trivial gossip of the town,— not only births, marriages, divorces, and deaths, murders, domestic infelicities, and accidents, but any unusual omens or prodigies, *lusus naturæ*, etc. Petronius in ‹Trimalchio's Feast› gives an admirable burlesque of it. The letters of Romans to out-of-town friends were regularly furnished with spicy news from the *Acta Diurna*, which seem to have taken the place of the older ‹Annales› or yearly chronicles, too slow for the active later republic and only reporting the more important occurrences, some time after 131 B.C. The usual statement is that Julius Cæsar introduced them; but it hardly seems probable that the Roman people, once used to even an imperfect form of news-gathering, dispensed with it altogether for three-quarters of a century and did not think of it again until it was invented for them. It is certain, however, that it was in use in Cæsar's time, for he ordered Antony's offer of a crown to him on the Lupercalia to be set down in the *Acta Diurna*. (Le Clerc, ‹Roman Newspapers,› in French, 1838, entertaining but not cautious in facts; Hübner, ‹Acta of the Roman Republic,› in Latin, Leipsic, 1860.)

Actæa, a genus of the natural order *Ranunculaceæ*, represented in the United States by the baneberries. *A. alba* or white cohosh, or baneberry, is found in rocky woods north from Georgia. *A. spicata*, red cohosh, or red baneberry, grows farther west and near to the north than the white baneberry.

Acta Eruditorum, the first literary journal of Germany. It was started in 1682 by Prof. Otto Mencke of Leipsic, and enjoyed a long existence and great popularity. It was owned by his family till 1754, after which it began to decline in value and in the number of its subscribers; and the irregularity of its appearance became at length so great that the last volume, for 1776, was published in 1782, exactly a century from the time when the journal was commenced. The whole consists of 117 quarto volumes, including the supplementary volumes and indices. In this journal Leibnitz first gave to the world his notions respecting the differential calculus.

Actæon, ak-tē'on, in Greek mythology, the son of Aristæus and Autonoë (a daughter of Cadmus), a great hunter. He was turned into a stag by Artemis (Diana) for looking at her when she was bathing (or, as some say, for boasting that he was superior to her in hunting), and was torn to pieces by his own dogs. This incident is exhibited in various ancient works of art.

Acta Sanctorum, or **Martyrum**, the collective title given to several old writings respecting saints and martyrs in the Greek and Roman Catholic Churches, but now applied especially to one extensive collection begun by the Jesuit Rosweyd, and continued by J. Bolland. The work was carried on (1661) by a society of learned Jesuits, who were styled Bollandists, until 1794, when its further progress was prevented through the invasion of Holland by the French. In recent times the undertaking has been resumed.

Actin'ia. See SEA-ANEMONE.

Actinia'ria (Gk. *aktis*, ray), the sea-anemones. See ANTHOZOA; SEA-ANEMONE.

Actin'ium. (1) A supposed metallic element, occurring in nature associated with zinc. Its existence was announced in 1881 by Dr. T. L. Phipson, who observed that certain salts of zinc gave a white precipitate of zinc sulphid which blackens upon exposure to light and returns again to its white state in the dark; the blackening effect not being observed when the substance is exposed to the light *under a sheet of glass*. Phipson attributed this action to the presence of a previously unrecognized element which he called *actinium* on account of the sensitiveness of its sulphid to light. The zinc sulphid with which he experimented appeared to yield about four per cent of actinium sulphid, and he suggested that "the presence of this new element in zinc will account, probably, for the discrepancies noticed in the equivalent of this metal as determined by various observers." The hydrate of actinium is described as a voluminous, white, gelatinous precipitate, with a slight tinge of salmon when seen in bulk. The anhydrous oxid is not volatile and has a pale fawn color. The sulphid is of a pale canary-yellow color, and when exposed to the direct rays of the sun, unshielded by glass, it becomes quite black in about 20 minutes. Dr. Phipson's account of the preparation of the salts of actinium is given in the ‹Journal of the Franklin Institute› for December 1881. The existence of the element is not now admitted by chemists. (2) A radioactive substance, presumably an element, discovered by A. Debierne in 1000. It gives off the same kinds of rays as radium, but the "emanation" that it emits dies away with great rapidity. Actinium, like radium and polonium, is prepared from pitchblende, and belongs to the iron group. See RADIOACTIVITY.

Actin'ograph, a name sometimes given to the actinometer (q.v.), especially when it is arranged so as to give an automatic record of the intensity of the light.

Actin'olite, a mineral in Dana's Amphibole group, having the composition $Ca(Mg,Fe)_3Si_4O_{12}$. It occurs in various forms, and includes the varieties nephrite, asbestus, smaragdite, urolite, cummingtonite, dannemorite, and grunerite. Actinolite is greenish in color, and occurs usually in the form of long slender crystals or in a fibrous and radiated state.

Actinom'eter, an instrument for measuring the intensity of the chemical action of the sun's rays. For use in photography for the judging of times of exposure, the essential part of the instrument is a strip of sensitive silver

paper, which is blackened by the sun's rays, the time required to darken the paper to a definite shade being taken as the index to the intensity of the light. Any other chemical action that light rays are capable of performing may be made the basis of an actinometer; but the indications of instruments in which the fundamental chemical changes are different will not necessarily agree with one another, because any given actinometer shows nothing but the intensity of the particular part of the spectrum which performs the chemical change upon which that instrument is based.

Actinomyco'sis, a disease due to a vegetable parasite, *Actinomyces bovis*, of the fungus class. This fungus lives its life in grasses and plants and thus infects cattle, in which animals it is comparatively frequent, causing the disease known as "lumpy jaw." These in turn affect man. See PARASITES.

In man the symptoms are often very obscure. Some infections of the lungs have appeared to be cases of pulmonary tuberculosis. Pathologically the disease is one of new connective tissue formation with abscess production. It is a chronic disease and often is a slow, suppurative affair affecting the tissues about the pharynx and neck. The bones, lungs, and intestinal tract may be affected. The diagnosis may be readily made by the microscope. Consult: Salmon, 'Investigation Relating to the Treatment of Lumpy-Jaw, or Actinomycosis in Cattle, Department of Agriculture Bulletin No. 2 (1893).

Actin'ophone, better known as the radiophone (q.v.)

Actinozo'a, or An'thozoa, a class of cœlenterates which exist only in the polyp state, not giving rise to a medusa form. They are represented by the sea-anemone (q.v.) and coral polyps. Their bodies are vase-shaped, usually fixed at one end, though most of them are capable of slowly moving about. They are provided with a digestive sac partially free from the body-cavity opening into it below, and held in place by six or eight mesenteries radiating from the digestive cavity and dividing the perivisceral space into chambers. The mouth is surrounded with a circle of tentacles, which are hollow, communicating directly with the perivisceral chambers. There is a slightly marked bilateral symmetry. To the edges of the mesenteries (usually the free ones) are attached the reproductive glands, both male and female, or of one sex alone; also the « craspeda,» or mesenterial filaments, which contain a large number of thread-cells (q.v.). The body is either entirely fleshy or secretes a calcareous or horny coral-stock, and when the species is social it is connected by a cœnenchyme. In some forms, as sea-pens (q.v.) the entire colony is capable of limited locomotion. There is no well-marked nervous system, but a plexus of fusiform ganglionic cells connected by nerve-fibres in the base of actinians. Reproduction takes place by self-division, gemmation, or by eggs, the sexes being separate or united in the same individual; the young undergoing a blastula and gastrula condition, and then becoming fixed.

The Actinozoa are divided into two sub-classes, the *Zoantharia*, and the *Alcyonaria* (qq.v.).

Action. *In law*, the formal demand of one's right from another person, made and insisted in a court of justice which has jurisdiction of the person and the subject-matter of litigation. In a quite common sense, action includes all the formal proceedings in a court of justice attendant upon the demand of a right made by one person, or party, of another in such court, including an adjudication upon the right, and its enforcement or denial by the court.

The parties to an action are called plaintiff and defendant, and the former is said to sue or prosecute the latter, hence the word suit instead of action. In some few instances the redress sought by a civil action consists in the recovery of some specific article of property wrongfully and unlawfully taken by the defendant from the plaintiff, but most frequently the object of an action is to obtain compensation in money for an injury complained of, which compensation is technically called damages.

The action is said to terminate properly at judgment.

Civil actions are those actions which have for their object the recovery of private rights, or of damages for their infraction.

Criminal actions are those actions prosecuted in a court of justice, in the name of the government, against one or more persons accused of a crime.

Transitory actions are those civil actions the cause of which might have arisen in one place or county as well as another.

Local actions are those civil actions the cause of which could have arisen in some particular place or county only.

Personal actions are those civil actions which are brought for the recovery of personal property, for the enforcement of some contract, or to recover damages for the commission of an injury to the person or property.

Real actions are those brought for the recovery of lands, tenements, and hereditaments. Mixed actions are those which partake of the nature of both real and personal actions.

In higher theoretical mechanics the word « action » is used to signify the value of a certain integral, whose form may vary according to the character of the problem in hand. In the case of a single particle the action is the space integral of the momentum of the particle, or it is double the time integral of its kinetic energy. In a system of such particles the total action is the sum of the actions of the constituent particles. It is probable that the physical principle corresponding to the mathematical expression called « action » will some day be exhibited to us in a simple form; but up to the present time no mathematician or physicist has succeeded in doing this. The importance of « action » as a mathematical conception may be seen from the following theorem, which has long been known: « If the sum of the potential and kinetic energies of a system is the same in all its configurations, then, of all the sets of paths by which the parts of the system can be guided by frictionless constraint to pass from one given configuration to another, that one for which the action is least is the natural one, and requires no restraint.» The theorem just stated is known as Maupertuis' « principle of least action.» There is also a principle of stationary action, and one of varying action; but it is impossible to elucidate these without a prohibitive amount of

mathematics. The last two principles were formulated by Sir William Rowan Hamilton.

In theoretical mechanics the word «action» is also used to signify a force acting upon a body, as in the expression «action and reaction.» See FORCE; MOTION, LAWS OF.

In applied mechanics the mechanism by which some operation is effected in a machine is often called the action of the machine; thus we speak of the action of a gun, meaning the mechanism governing the loading and firing of the gun; or of the action of a piano, meaning the combination of keys, hammers, and other parts, by which the player causes the strings of the instrument to vibrate.

In psychology. See EXPRESSION.

Actium, ak'shium, Greece, now **La Punta**, lä poon'ta: a promontory on the W. coast jutting out from the N.W. extremity of Acarnania, on the Ionian Sea at the entrance of the Gulf of Arta (old Ambricia), opposite Prevesa and just N. of Santa Maura (old Leucadia). Forts Punta and Aktium defend it. It represents one of the greatest of historical landmarks: the naval battle of 2 Sept. 31 B.C., between Octavianus (later the Emperor Augustus) and Antony, which decided the mastership of the then civilized world. For the reasons of the engagement, see ANTONIUS: it was fought by him, not for victory but for escape, which partly explains its half-heartedness and result on his side. Both armies were drawn up on the shore watching it. After waiting four days for a calm they engaged about noon on the fifth. Antony had some 500 large ships, Octavianus fewer and lighter ones. Antony on his right was opposed to Agrippa, Octavianus on his to Cælius; Cleopatra's 60 were in the rear. Antony's vessels were huge hulks, too clumsy for manœuvring; but on the other hand so impenetrable with iron-bolted timbers and brass plates and spikes that Octavianus' galleys dared not ram them for fear of shattering themselves, and skirmished rapidly around, hurling missiles and trying to board. It was more like the besieging of forts than a naval battle: one of Antony's tall structures being often surrounded with three or four of its nimble foes pouring darts and fire-balls into it, to which it replied from catapults loaded with heavy missiles. At length Agrippa used his superior numbers to attempt a flanking movement; Antony's flag-captain drew his wing away from the centre to prevent it: Cleopatra took alarm, and to make sure of escape her squadron broke through the front rank, throwing it into disorder, and sailed away for Egypt. Antony jumped into a small galley and followed her, leaving his command to its fate: even so it fought on till about 4 P.M., when 300 ships had been taken and many burned, and 5,000 men killed; it then yielded. The land army surrendered a week later. In commemoration of the triumph Octavianus enlarged the temple of Apollo at Actium, dedicated his trophies there, instituted quinquennial games, and built Nicopolis («city of victory») on the site of his army's camp, near the modern Prevesa. (Plutarch's ‹Life of Antony› is the only first-hand account in an English translation; and Dion Cassius, in Greek, is much later and less judicious.)

Active Constituents of Plants. See PLANTS.

Act of God, an accident which arises from a cause which operates without interference or aid from man. The term is sometimes used as equivalent to inevitable accident, but incorrectly according to some authorities, although Sir Wm. Jones proposed the use of «inevitable accident» instead of «act of God.»

Act of Settlement, an act of the Parliament of England in 1701, vesting the hereditary right to the English throne in Sophia, Electress of Hanover, and her Protestant descendants, constituting the source of the sovereignty of the House of Hanover or Brunswick, the present ruling line. The act prohibited the king (or queen) from going to war in defense of non-English powers without the assent of Parliament.

Act of Supremacy. (1) An act of the Parliament of England, in 1534, by which the king was made the sole and supreme head of the Church of England. (2) A re-enactment of the above, with changes, in 1559.

Act of Toleration, usually known as the TOLERATION ACT, an act of the reign of William and Mary, granting freedom of religious worship, under certain comparatively moderate conditions, to all dissenters from the established Church of England except Roman Catholics and persons denying the Trinity. This act, as confirmed in the reign of Anne, was the basis of various subsequent measures of religious toleration, culminating in the Catholic Relief Act of George IV. and the still more liberal legislation of Victoria.

Act of Uniformity. (1) An act of the Parliament of England (1559) adopting a revised liturgy for the Church of England, entitled «An Act for the Uniformity of Common Prayer and Service in the Church, and Administration of the Sacraments.» (2) An act of Parliament (1662) requiring that the revised Book of Common Prayer and Ordination of Ministers, and no other, should be used in all places of public worship and be assented to by clergymen. By this test more than 2,000 non-conforming clergymen were ejected from their churches. It took effect on St. Bartholomew's Day (24 Aug. 1662), and accordingly is known in English history as the «Bartholomew Act,» the day of its enforcement being known as «Black Bartholomew.»

Acton, John Emerich Edward Dalberg, baron, historian: b. Naples, 10 Jan. 1834; d. Bavaria, 19 June 1902. He was educated under Dr. (afterward Cardinal) Wiseman at Oscott College, England, and at Munich under Ignatius von Döllinger, whose friend and adherent he remained throughout life. He was returned to Parliament for Carlow (1859) and for Bridgnorth (1865), but was unseated on a scrutiny of the vote; created a peer (Baron Acton of Aldenham) in 1869 by Gladstone, whose trusted friend and adviser he was. A strong Liberal in politics and religion, he founded the ‹Home and Foreign Review› (1862–4) in the interest of the liberal Catholic party, and adopted the Home Rule idea before Gladstone himself. At the Œcumenical Council in Rome (1870) he vigorously opposed the dogma of papal infallibility. From 1895 to 1902 he held the office of regius professor of modern history at Cambridge Uni-

versity. A scholar of wide and vast erudition, his passion for acquiring knowledge seemed to act as a check upon his productive powers. No modern man of such first-rate abilities has left so few literary productions by which posterity may judge of those abilities. Between 1868-90 he gave to the press a few historical essays and anonymous letters; and in 1895 he published a ‹Lecture on the Study of History.› In 1882 he planned a comprehensive history of liberty, but never carried out the design. His university lectures were models of narrative, fulness of thought, and flawless exactitude of statement. ‹The Cambridge Modern History› (vol. 1, 1902) was planned and outlined by him.

Acton, Sir John Francis Edward, English adventurer, son of an English physician and a French lady: b. Besançon, France, bapt. 3 June 1737; d. Sicily, 12 Aug. 1811. Entering the Tuscan navy under his uncle's auspices, he commanded a frigate in the Algerian expedition of 1775, performed daring exploits in covering its retreat, and attracted the notice of Caramanico, favorite of Queen Caroline of Naples; and the queen, ambitious of playing a large European part, persuaded her brother, the Grand Duke of Tuscany, to lend Acton to her to reorganize her navy. He soon became her prime favorite, commander-in-chief by both land and sea, and ultimately prime minister, shelving Caramanico on foreign missions. He improved the roads and ports, but excited great discontent by the consequent taxation and the positions given to foreigners. In 1793 he formed the league between Naples, Austria, and England against France; in 1798 the French victories forced him to fly with the royal family to Sicily, and the Parthenopean Republic was formed. Five months later they were back, and he, with a «Junta of State,» instituted a reign of terror, sending many to the prison or the block. In 1804 he was removed at French demand, and in 1806, when the French entered Naples, he was obliged to take refuge in Sicily again, where he died with the ill will of all parties.

Acton, Thomas Coxon, American financier and public official: b. New York city, 23 Feb. 1823; d. there, 1898. He was a leading banker, and in early years was assistant to the county clerk, and deputy register; 1860-9 metropolitan police commissioner, 1862-9 president of the board. During the draft riots of July 1863 he commanded the entire police force in person for a week, rendering highly valuable service. He was superintendent of the United States Assay Office 1870-82, and assistant treasurer of the United States at New York 1882-6. He was always an active agent in administrative and social reforms in the city; carried through against bitter opposition the creation of a paid fire department; and assisted in founding the Society for the Prevention of Cruelty to Animals and the Society for the Prevention of Cruelty to Children. He declined a nomination for mayor.

Acts, Apocryphal. See Apocrypha.

Acts of the Apostles, fifth of the New Testament canon, and last of the canonical narratives of Christian origins: and, aside from the meagre notes in the Epistles, our one source of the history of Christianity for the first thirty or thirty-five years after the death of Christ. Immemorial tradition has assigned it to the author of the Gospel of Luke, and from the close resemblance of matter, tone, and evident purpose, modern criticism is inclined to validate this, though there are some discrepancies not easy to explain if so. In any case the author of each was a Gentile Christian, writing to explain to pagan Gentiles the origins of Christianity, and its spread by divinely directed methods from Jews to Gentiles; but the «Acts» is the later, showing some theologic development, very harsh toward the non-Christian Jews, and attributing all harassing of the apostles and resisting of the extension of the gospel to them and not the Gentiles, who in fact are called into the fold because the Jews will not listen. Both are anxious also to show that the Roman government from the first had no hostility to the new movement, and rather favored it but for Jewish pressure: Pilate admires and wishes to save Jesus; Paul's first converts are Roman officers, and the Roman magistrates find no crime in him and go out of their way to screen him from conspiracies. A further and strong object of the «Acts» is to show that the first Christians were of one heart and soul, without selfishness or jealousy and single in aim: they distribute their possessions and have all things in common; they accompany and take the tenderest farewells of each other; and there is no book with more beautiful and attractive characters,— Stephen, Cornelius, Lydia, the jailer at Philippi, etc. Hence too some of the divergences from the facts stated in other books, and presumably true as there was no motive for their invention, but the reverse: for instance, the bitter conflicts of Paul with the other heads, as told in Galatians and Corinthians. The apostles and Paul are the co-foundations of the Christian world, at God's will. But the notion that the book is a Pauline apology is contradicted by its matter: not only are conditions laid down for an apostle which would exclude Paul (i. 21 sqq.), but the narrator takes pains to show that Paul only followed in the footsteps of the apostles and originated nothing. The suppression of his wanderings in Arabia, Syria, and Cilicia makes it appear that Peter and not he gained the first Gentile convert; Peter's miracles duplicate his in remarkable number and exactness; and in nearly all cases, when Paul goes into a strange town to preach, he cannot gain the right till he has first attempted to preach to the Jews and been rejected by them, thereby forcing him to appeal to the Gentiles. In one place (xxviii. 17-28) the existence of a prior Christian Church is actually ignored to this end; and after Jesus' appearance to Paul he still has to be inducted into his work by human hands (Ananias and Barnabas), though the church at Antioch — the first Gentile Christian church and Paul's first important congregation — has already been founded by Christians from Jerusalem. The real hero of the book is the united, co-equal, self-abnegating band of God-sent Christian missionaries.

The title is probably not the original and certainly not the correct one: nine of the apostles are mentioned only by name, and James and John hardly more; while it is much fuller on several subordinate figures than on any others but Peter and Paul,— the deacons Stephen, Philip, Apollos, Cornelius, etc. It professes to

be the relation of an eye-witness, and in a portion of the narrative uses the personal "we"; but this relation — which is entirely trustworthy — forms but a small part of the book, and represents a document (probably a journal) by a companion of Paul, which the later actual writer used, in part bodily, in part as unavowed material, claiming its credit for his entire work. This is shown among other things by the excessive minuteness of the itinerary and other unimportant items in some cases, contrasted with the vague generality of others, its ignorance of the most important facts or traditions (the gift of tongues, for instance, and Paul's wanderings), or even categorical contradiction of others, as the contentions of Paul. Whether this is lack of knowledge or "tendency" writing, it equally shows the composite nature of the work; as do the discrepancies in relating the same facts: for example, in ix. 7, Paul's companions hear a voice but see no one; in xxii. 9 they see the light from heaven but hear nothing; in xxvi. 12–18 they fall down with Paul but nothing more is told. The other sources — oral traditions and lost works — doubtless enshrined much genuine history. The theory that it is a later recension of his own work by "Luke," from an earlier rough-draft represented by the "we" narrative, is not sustained.

The minimum date is approximately fixed by the fact that the author knows Josephus' works, which began with the "Jewish War," 79 A.D., and ended with his autobiography, shortly after 100; it cannot therefore be much earlier than 105, or if "Luke" knew Josephus also, about 110. The maximum is reckoned about 130; but curiously, Marcion, c. 140, had the Third Gospel but not "Acts," or if he had it he rejected it. In any event it is of the first half of the 2d century, which agrees also with its tone toward the Roman power. The "Good Emperors" reigned 96–180 A.D. The chief critical examinations are in German: H. Meyer (ed. Wende, Göttingen 1899); Ewald, 'The First Three Evangelists and the Acts of the Apostles' (Göttingen 1872).

Actuality, Law of, in philosophy, the state of being actual; reality. "The actuality of these spiritual qualities is thus imprisoned, though their potentiality be not quite destroyed."— Cheyne.

Actuarial Society of America, a scientific organization, established in April 1889, having for its object the promotion of actuarial science by such methods as may be found desirable. The membership is composed of those connected with actuarial pursuits. The enrollment is divided into members and associates. Candidates for associate are required to pass such preliminary examination as may be prescribed; a second examination is demanded of candidates for member. An annual meeting is held on the first Thursday after 14 May in each year. Other meetings may be called by the council from time to time and by the president at any time on the written request of 10 members. The officers of the society are a president, a first and second vice-president, a secretary, and a treasurer. President and vice-presidents are not eligible for the same office for more than two consecutive years. The council is composed of the officers and six other members, two elected to serve for three years, two for two years, and two for one year. The society publishes 'Transactions,' containing the proceedings of the meetings, including original papers presented by members or associates, discussions on said papers, and other matter expressly authorized by the council. On 1 June 1903 the total number of members was 123; that of associates, 29. Enrollment is not restricted to the United States. Office of the secretary, 32 Nassau Street, New York.

Actuary, in ancient Rome, a clerk of public bodies who recorded their *acta;* also one of the public reporters who prepared the daily news of the city as a written newspaper. (See ACTA DIURNA.) In modern times, the mathematician of an insurance company, who makes the calculations on which its policy plans and prices are based, and applies the doctrine of probabilities to fire, life, or accident insurance. Although the material on which he works is theoretically furnished by the experience of his and other cognate companies, and the records of public and private bodies, with the common rules of interest, in fact it needs not only great mathematical capacity but great practical sagacity to apply them to actual business; and no actuary of the highest class is a mere mathematician. In the early days, when experience was still mostly to make, the actuaries were usually the presidents of their companies; in recent times a safe body of experience has accumulated which enables business men to head them, and the actuary's computations and advice relate to slighter variations or special plans. In accident companies the actuary needs to be and usually is a man of large practical acquaintance with different employments, their hazards, the meaning of given employment-names, and those under which the more hazardous employments are disguised as less so; in fire insurance equally he must know the character of different risks. See INSURANCE.

Acuña, Manuel, ä-koon'yä, män-oo-el', Mexican poet: b. 1849; committed suicide 1873 from disappointed love, which was the principal theme of his poems.

Acuña de Figueroa, Francisco, ä-koon'yä dā fē-gā-rō'ä, frän-thēs'kō, Uruguayan poet: b. Montevideo, 1791; d. there, 6 Oct. 1862. His works are a Spanish-American classic from their metrical perfection, though deficient in warmth. The collection 'Poetic Mosaic' comprises every variety of secular and religious poetry, from heroic poems to psalms.

Adair', James, American 18th-century Indian trader and author. He lived 1735–75 among the Indians, mainly the Cherokees and Chickasaws; and in the latter year published a 'History of the Indian Tribes,' especially the southeastern ones, containing an admirable first-hand account of their manners and customs, and a still more valuable though unsatisfactory set of Indian vocabularies. But the chief object of writing the book was to trace the origin of the Indians to the Lost Tribes of Israel; a curious phantasm (especially as the tribes are known not to have been lost, and the differentiation of stocks must far antedate the Christian era) which has bewitched many enthusiasts since, and was revived and expounded by Dr. Elias Boudinot in his 'Star of the West' (1816). Adair's views are summarized in H. H. Bancroft's 'Native Races,' vol. 5, p. 91.

Adair, John, American general and public officer: b. Chester co., S. C., 1759; d. Harrisburg, Ky., 18 May 1840. He served in the Revolution; removed to Kentucky 1787; in 1791 was major under St. Clair and Wilkinson in the northwestern Indian expeditions, and was defeated by the Miami chief «Little Turtle» near Fort St. Clair. He was a member of the constitutional convention which made Kentucky a State, 1 June 1792; was State Representative and Speaker, register of the United States Land Office, and 1805–6 United States Senator. He was volunteer aid to Gen. Shelby at the battle of the Thames, 5 Oct. 1813; made brigadier-general of State militia Nov. 1814, and as such commanded the State troops at New Orleans under Jackson, 8 Jan. 1815. He was governor of Kentucky 1820–4, and United States Representative 1831–3, on the committee on military affairs.

Adair, Robin. See ROBIN ADAIR.

Ad'albert, or **Al'debert,** a native of France, who preached the gospel in 744 on the banks of the Main. He is remarkable as the first opponent to the introduction of the rites and ordinances of the Western Church into Germany. He rejected the culture of the Saints and Confession, but distributed his own hair as sacred relics to his followers; was accursed of heresy by Boniface the apostle of Germany, and condemned by two councils, at Soissons in 744 and at Rome in 745. Finally escaping from prison, he is said to have been murdered by some peasants on the banks of the Fulda.

Adalbert, St., of Prague, the apostle of Prussia proper: b. 939; d. 23 April 997. He was the son of a Bohemian nobleman, and his real name was Voitech («host — comfort»); was educated in the cathedral of Magdeburg, and appointed the second bishop of Prague in 983. He labored in vain to convert the Bohemians from paganism, and to introduce among them the ordinances of the Church of Rome. Discouraged by the fruitlessness of his pious zeal, he left Prague (988) and lived in convents at Montecasino and Rome until the Bohemians in 993 recalled him; but after two years he again left them, disgusted with their barbarous manners. He returned to Rome, and soon followed the Emperor Otho III. to Germany; on which journey he baptized, at Gran, St. Stephen, afterward king of Hungary. He proceeded to Gnesen to meet Boleslas, Duke of Poland. Being informed that the Bohemians did not wish to see him again, he resolved to convert the pagans of Prussia, but was murdered by a peasant near what is now Fischhausen. His body was bought by Boleslas for its weight in gold, and became famous for its miraculous power. Its influence was greater than that of the saint himself: the Bohemians, who had refused to receive the ordinances of the Church, now suffered them to be introduced into Prague, on the sole condition that these miraculous relics should be transferred to their city. They were rediscovered in a vault in 1880 and deposited in the cathedral. (Life by Heger, Königsberg 1897; Voigt, Berlin 1898.)

Adalbert, «The Great,» Archbishop of Bremen and Hamburg: b. about 1000; d. 17 March 1072; descendant of a Saxon princely house. He received his office in 1043 from the Emperor Henry III., whose relation, friend, and follower he was. He accompanied Henry to Rome in 1046 and was a distinguished candidate for the papal chair. Pope Leo IX. made him his legate in the north of Europe (1050). He superintended the churches of Denmark, Norway, and Sweden, converted the Wends, and aspired to a great northern patriarchate to vie with the Roman Curia. During the minority of Henry IV. he usurped, in concert with Hanno archbishop of Cologne, the guardianship of the young prince and the administration of the empire, and gained an ascendancy over his rival by indulging the passions of his pupil. After Henry had become of age Adalbert exercised the government without control in his name. His pride and arbitrary administration induced the German princes in 1066 to remove him by force from the court; but after a short contest with the Saxon nobles, who laid waste his territory, he recovered his former power in 1069, and held it till his death in Goslar in 1072. His injustice and tyranny were instrumental in producing the confusion and calamities in which the reign of Henry IV. was involved.

Adalia, Turkey in Asia, a seaport on the S. coast, in the vilayet of Konieh, finely situated on the Gulf of Adalia, from which the houses rise in terraces like an amphitheatre, on a rocky hill and surrounded by fig, orange, and mulberry gardens. It lies in a fertile but hot and unhealthy locality, producing grain, figs, oranges, wine, etc. It has a small but good port, and carries on a considerable trade; exporting grain, timber, cattle, valonia, etc. It was anciently called Attalia, later Satalia. Pop. about 30,000, 7,000 Greeks.

Adam («one made») and **Eve** («living being,» feminine). As the Old Testament almost invariably uses the article before «adam» («the adam» = «the made one» or «the man»), its use as a personal name is a mere misapprehension, and the implications drawn from it are no part of the text; nor is there any reason to suppose it was so intended by the writers who used it, or so understood by the Jews. This, however, is a minor point, as the narratives of the creation and fall, etc., have the same bearing whether the first created beings had names or not: they remain themselves no less. But those narratives were certainly not understood by their compilers themselves, who merely took them from Babylonian sources (see CREATION), as implying literal history,— which their discordance should render obvious,— and the difficulties involved in it result from being more Biblical than the Bible, as the Yahvistic portions of the later chapters disregard them, and the Yahvish adds to them at will. The accounts in Genesis are three: (1) The Elohistic (q.v.), in which «male and female» are created at the same time; that is, the whole race, just as the whole animal race is created at a stroke. The interpretation as «one couple» is thrown back from the second account. (2) The Yahvistic, in which «the adam» is made from the dust, and «the eve» from the adam; and which contains the theological part of the story,— the location in the Garden of Eden, the prohibition of God and its disregard, the expulsion, the birth of Cain and Abel, and the first murder. (3) The genealogical list in chapter v., where the race is

derived through Seth, and Cain and Abel are unknown; and where the first generations of men are demigods with enormous spans of life. The last is not only later than the other two, and corresponding to Greek, Assyrian, etc., pedigrees carrying the race or its first families back to the gods, but it is entirely unconnected with the first two, which have a certain relation as efforts of early man to account for the origin and propagation of life on the earth, which every race has undertaken as soon as it attained self-consciousness. The first, however, is that pure and simple, with no ulterior purpose. The second is quite other, combining the creation story of a single couple, the progenitors of the human race,— as with the Greek Deucalion and Pyrrha, etc.,— with a deeply moralized account of the origin of moral evil, and the rapine and violence, pain and disease and hardship, which it brought into a world previously free from them. It is this, reflecting the predominant religious tone of the Jewish mind, that has formed the basis first of the Jewish and then of its successor the Christian theology: Adam as the reason for and spring of human sin. This resulted in Paul's conception of two Adams: the fleshly one, whence come sin and death; and the spiritual one, whence springs salvation.

Most of the later Jews regarded the story as an allegory. Philo, the foremost writer of the Alexandrian school, explains Eve as the sensuous part, Adam as the rational part, of human nature. The serpent attacks the sensuous element, which yields to the temptation of pleasure and next enslaves the reason. Clement and Origen adapted this interpretation somewhat awkwardly to Christian theology. Augustine explained the story as history, but admitted a spiritual meaning superinduced upon the literal; and his explanation was adopted by the reformers, and indeed generally by the orthodox within the Catholic and the various Protestant Churches alike. More modern critics, loth to abandon it wholly as legend, have sought to separate a kernel of history from the poetical accretions, and attribute the real value of the story not to its form, but to the underlying thoughts. Martensen describes it as a combination of history and sacred symbolism, «a figurative presentation of an actual event.» The second narrative may be regarded as embodying the philosophy of the Hebrew mind applied to the everlasting problem of the origin of sin and suffering: a question the solution of which is scarcely nearer us now than it was to the primitive Hebrews. Hesiod describes man in his primitive state as free from sickness and evil before Prometheus (q.v.) stole fire from heaven, and Pandora (who corresponds to Eve) brought miseries to the earth. Prometheus gives man the capability of knowledge; his daring theft is for man the beginning of a fuller and higher life. Æschylus regards Prometheus as the representative of humanity led into misery by his self-will until he submits to the higher will of God. This corresponds with the story of Genesis, save that in the latter the spiritual features are clearer and more distinct.

Adam, Graeme Mercer, Canadian author and editor: b. Scotland 1839. He was trained in Blackwood's publishing house in Edinburgh, and, emigrating, became a publisher in Toronto and New York. He later edited several Canadian periodicals, assisted Goldwin Smith on the ‹Bystander,› and founded with him the ‹Canadian Monthly› (1872). In 1879 he founded the ‹Canadian Educational Monthly.› In 1896 he became editor of ‹Self-Culture.› He has written ‹An Outline History of Canadian Literature› (1886); ‹The Canadian Northwest› (1895); and with Ethelwyn Wetherald, the historical novel ‹An Algonquin Maiden›; etc.

Adam, Juliette, ad-äṅ, zhü-lē-et (MME. ADAM, née LAMBER), prolific Parisian journalist and author: b. Verberie, Oise, 4 Oct. 1836. She founded in 1879 the *Nouvelle Revue*, the organ of the Extreme Republicans, and edited it till her retirement in 1897; and her salon was a noted influence in Paris. Her second husband, Edmond Adam (later life senator, d. 1877), was prefect of police in Paris during the Prussian siege, and her first book was a diary of the siege. She has written largely (often under the pseudonyms Juliette Lamber and Comte Paul Vasili) on women's rights and various literary and social subjects; novels assailing Christianity for its crucifixion of natural instincts; ‹The Hungarian Fatherland› (1884), ‹General Skobeleff› (1886), etc.

Adam, Quirin François Lucien, ad-äṅ, kē-raṅ fräṅ-swä loo-seaṅ, French philologist: b. Nancy, 1833. His works, largely devoted to the study of primitive or savage tongues, have included among others American Indian subjects, as ‹Sketch of a Comparative Grammar of Cree and Chippeway› (2d ed. 1876); ‹Studies on Six American Languages› (1878); also ‹Grammar of the Manchouc Language› (1873); ‹Lorraine Patoises› (1881); ‹Negro-Aryan and Malay-Aryan Idioms› (1883).

Adam, Book of. See APOCRYPHA.

Adamant, a word loosely used to signify a substance of extreme hardness. It is probably derived from the Greek *adamas*, «unconquerable.» Very possibly the name adamant was at one time applied to a definite substance; but it has been used to signify corundum, various gems, a hard metal (probably steel) that was used in making armor, the lodestone, and various other substances. It is now chiefly used in a poetical or rhetorical sense.

Adamantine Spar, a name sometimes applied to corundum (q.v.) on account of its hardness; especially to the dark colored, non-transparent varieties which are used in pulverized form for polishing gems.

Adaman'toid, a crystalline form belonging to the isometric system, and bounded by 48 similar scalene triangles. It has 6 octahedral solid angles, at the extremities of the principal axes; 8 hexahedral solid angles, at the extremities of the trigonal axes; and 12 tetrahedral solid angles, at the extremities of the digonal axes. Its name is due to the fact that the diamond usually occurs in this crystalline form. (Also, and more commonly, called hexoctahedron.)

Adamawa, ä'da-mä'wa (formerly FUMBINA), an internally autonomous sultanate of central Africa, between lat. 6° and 11° N., and lon. 11° and 17° E.: part of the Sokoto empire in northern Nigeria; area some 50,000 sq. m. Much of the surface is mountainous, the mountains rising to about 8,000 ft. The princi-

pal rivers are the Benue and its tributary the Faro. The eastern part belongs to the German Kamerun; the western to British North Nigeria. A great part of the country is covered with thick forests, though there are also extensive and splendid pasture lands and cultivated fields. The native inhabitants are industrious and intelligent, but they have been in a great measure subdued by the Mohammedan Fulahs, who possess innumerable slaves. Slaves and ivory are the chief articles of trade. Pop. conjectured at 3,000,000. Chief towns, Yolo the capital, est. 12,000 to 20,000; Banjo, chief ivory mart; and Nganudere.

Adam Bede, the earliest of George Eliot's novels, was published in 1859 as « by the author of ‹ Scenes of Clerical Life. ›» A skeleton of the plot gives but a poor impression of the strength and charm of the story. It seems to have been, in the author's mind, a recognition of the heroism of commonplace natures in commonplace surroundings, of the nobility of noble character wherever found. But Adam Bede, intelligent, excellent, satisfactory though he is, is subordinated in interest to the figure of Hetty, made tragic through suffering and injustice. Dinah Morris, the woman preacher, is a study from life, serene and lovely. Mr. Irwine is a typical English clergyman of the early 19th century; Bartle Massey, the schoolmaster, is one of those humble folk, full of character, foibles, absurdities, and homely wisdom, whom George Eliot draws with loving touches; while Mrs. Poyser, with her epigrammatic shrewdness, her untiring energy, her fine pride of respectability, her acerbity of speech, and her charity of heart, belongs to the company of the Immortals.

Adam de la Hale, or **Halle**, ad-äṅ duh lä äl, French poet and composer: b. Arras about 1235; d. Naples about 1287· nicknamed the Hunchback of Arras, although he was not deformed. His satirical extravaganza, ‹ The Play of Adam, or The Play in the Arbor › (1262), constitutes the earliest comedy in the vulgar tongue; while the pastoral drama, ‹ The Play of Robin and of Marion,› may be looked upon as the earliest specimen of comic opera.

Adami, Friedrich, ä-dä'mē, frēd'rïн, German author: b. Suhl, 18 Oct. 1816; d. Berlin, 5 Aug. 1893. He wrote stories, plays, etc., a very popular biography of Queen Louise, and ‹ The Book of Emperor William › (1887–90).

Ad'ami, John George, English-American pathologist: b. Manchester, Eng., 1862; educated at Owens College there and Christ's College, Cambridge; studied at Breslau and Paris; became demonstrator of pathology at Cambridge in 1887; fellow of Jesus College 1891. In 1892 he came to Montreal as professor of pathology at McGill University; from 1894 has been head of the pathological department at the Royal Victoria Hospital there; from 1896 lecturer to the New York Pathological Society. He has published papers on pathological topics, and articles in Allbutt's ‹ System of Medicine.›

Adamine, a mineral better known as adamite.

A'damite (named for M. Adam, a French mineralogist), a mineral, isomorphous with olivenite, and occurring in small orthorhombic crystals that are often grouped in fine granular aggregations. It is an arsenate of zinc, having the formula $Zn_3As_2O_8.Zn(OH)_2$, although copper and cobalt may also be present. Its hardness is 3.5, and its sp. gr. 4.35. Its color is variable. It occurs at Cap Garonne, near Hyères, France; and also at Laurium, Greece, and in certain parts of Chile.

Adamites. (1) A Christian sect said to have existed in the 2d century: so called because both men and women appeared naked in their assemblies, either to imitate Adam in the state of innocence or to prove the control which they possessed over their passions. The tradition is probably baseless, originating in a name of derision given to the Carpocratians. (See GNOSTICS.) (2) Also called Picards, from the founder of their sect, Picard (perhaps also Beghards). He called himself Adam the Son of God, and advocated community of women. They appeared about the year 1421 on an island in the River Lusinicz, where Zisca surprised them, but was not able to destroy the whole sect. In the following year they were widely spread over Bohemia and Moravia, and especially hated by the Hussites (whom they resembled in hatred toward the hierarchy) because they rejected transubstantiation, the priesthood, and the Supper. They subsequently formed one sect with the remaining Taborites, who have accordingly been confounded with them. In 1849 a similar sect sprang up in Austria.

Ad'amnan, St. (dim. of Adam), an Irish ecclesiastic and author: b. in Donegal, c. 625; d. 703 or 704. He was descended from a cousin of St. Columba and from powerful Irish chieftains. Entering the monastery of Iona, he became abbot in 697; but was involved in quarrels with his monks over Easter and the tonsure (enforcing the orthodox Roman view against the Irish Church view), which hastened his death. He wrote a most valuable life of St. Columba (q.v.), the founder of Iona, full of historical information about the early Irish-Scotch Church (best edition Reeves', 1857; English translation in the ‹ Historians of Scotland,› 1874, reissued Oxford 1895); and a hearsay but valuable report of matters in Palestine in his time, the first we have of that land in the early Middle Ages.

Adam of Bremen, celebrated German historian: b. probably in Meissen, Saxony; d. 12 October of an unknown year, probably 1076. He lived at Magdeburg, removed to Bremen in 1067, was made canon of its cathedral and next year principal of the cathedral school. His fame rests on his ‹ History of the Church of Hamburg › (1072–6), an inestimable mediæval classic, for which he gathered material far and wide; making a special trip to Denmark to interview King Svend Estridson, whose communications he gives. As an appendix to his last book he gives an account of the Danish, Swedish, and Norwegian possessions, containing a passage of the first interest to Americans, as verifying the Saga stories of Vinland: « He [Svend] told of still another island found by many in that [Atlantic] ocean. It is called Wineland, because grapes grow there spontaneously. . . . I have learned through definite information from Danes that unsown crops also grow there in abundance.»

Adam of St. Victor, famous mediæval hymnologist: d. in Paris c. 1192; nothing is known of him save his great hymns, the most numerous of any mediæval writer, and among the foremost in rank. A few have been finely translated by J. M. Neale; a complete (so far as known) edition was published in London, 3 vols. 1881.

Adam Family, British architects, a celebrated 18th-century family consisting of William and his four sons, William, Robert, James, and John: of whom Robert ranks first and James next. The father was born in Fifeshire, Scotland, and his work was done in his native country: the town hall at Dundee, the library and university at Glasgow, and many other public and private buildings there and in Edinburgh, etc. Robert was born in Edinburgh, studied in Italy, and examined the noble remains of Dalmatia before settling in London: his work on Diocletian's palace at Spalato was a valuable advertisement to his talents and taste, and all the brothers increased their repute by publishing engravings of their plans. Under Robert's direction they constructed a great number of buildings in London,— the Adelphi Terrace and the streets around commemorates them specifically. He also did much to remodel the appearance of the city. Robert also built Lansdowne House, Kedleston Hall near Derby, and Register House near Edinburgh. A special feature of the brothers' work was their careful attention to harmonious interior arrangement and decoration.

Adam's Apple, in botany, (1) the name given by Gerard and other old authors to the plantain tree (*Musa paradisiaca*), from the notion that its fruit was that sinfully eaten by Adam in Eden. (2) The name given, for the same reason, to a species of *Citrus*.

In anatomy, a protuberance on the fore part of the throat, due to the thyroid cartilages. The name is supposed to have arisen from the absurd popular notion that a portion of the forbidden fruit, assumed to have been an apple, stuck in Adam's throat when he attempted to swallow it.

Adam's Bridge, or **Ra-ma's Bridge,** a chain of shoals across the Gulf of Manaar, between Hindustan and the island of Ceylon, in the Rāmāana fabled to have been constructed by monkeys.

Adam's Peak, one of the highest mountains in the island of Ceylon, about 45 m. E. of Colombo. It is of a conical shape, 7,420 ft. high, and can be seen in clear weather from sea 150 m. away. From its solitary position and immense height above the surrounding country the peak forms a striking and awe-inspiring object and has been for centuries venerated by the inhabitants. On the top, under a sort of open pagoda, is the sacred footmark, a natural hollow in the rock, artificially enlarged, and bearing a rude resemblance to a human foot. Mohammedan tradition makes this the scene of Adam's penitence after his expulsion from Paradise; he stood 1,000 years on one foot weeping for his sin, hence the mark. To the Buddhists, the impression is the *Sri-pada,* or sacred footmark, left by Buddha on his departure from Ceylon; and the Hindus recognize Buddha as an avatar of Vishnu or Siva. Devotees of all creeds here meet and present their offerings (consisting chiefly of rhododendron flowers) to the sacred footprint, finishing their devotions by a draught from the sacred well. The ascent of the mountain is very steep, and toward the summit is assisted by steps cut and iron chains riveted in the rock, the last 40 feet being accomplished by an iron ladder. The top is an area of 64 feet by 45.

Adams, Abigail Smith, wife of President John Adams: b. Weymouth, Mass., 23 Nov. 1744; d. 28 Oct. 1818. She was daughter of a Weymouth clergyman, who opposed the match and took for a text «My daughter is grievously tormented with a devil.» Though lacking strength and regular school education, she became a self-made force of high order in public affairs and one of the best of early American writers: her letters to her husband, collected and published, are not only of great historical and social value, but full of delightful genial humor and acute comment and judgment. Her husband's position kept them apart for years; but she joined him in France in 1784, went with him to his life of torment in London, and lived in Washington 1789–1801; thence till death at Braintree, now Quincy.

Adams, Alvin, founder of Adams Express Co.: b. Andover, Vt., 16 June 1804; d. 2 Sept. 1877. On 4 May 1840 he started an express business between Boston and New York which developed into the great company above named, formed in 1854 by the consolidation of several rival firms,— including Harnden's, the initiator of the express business,— with Mr. Adams as president. In 1850 he helped to organize the pioneer express service through the California mining camps, which on the consolidation above he sold out. In the Civil War the Adams Express Co. was of immense help to the government; in 1870 it extended its business to the far West.

Adams, Brooks, American social writer, son of Charles Francis: b. Quincy, Mass., 2 June 1848; was graduated at Harvard in 1870; and practised law till 1871. Besides magazine papers he has written ‹The Gold Standard,› ‹The Emancipation of Massachusetts,› a bitter assault on the Puritan theocracy (1887). ‹The Law of Civilization and Decay,› and (1900) ‹America's Economic Supremacy.›

Adams, Charles Baker, American naturalist: b. Dorchester, Mass., 1814; d. 1853. He was graduated at Amherst; assisted in the geological survey of New York, 1836; held scientific chairs in Amherst (1836–8), Middlebury College, Vt. (1838–47), and Amherst again (1847–53); State geologist of Vermont 1845–7. He wrote a geological text-book.

Adams, Charles Follen, American dialect poet: b. Dorchester, Mass., 21 April 1842; Union soldier; began writing broken German poems in 1872; author of ‹Leedle Yawcob Strauss, and Other Poems› (1878); ‹Dialect Ballads› (1887), etc.

Adams, Charles Francis, American statesman, son of President John Quincy: b. in Boston, 18 Aug. 1807; d. there 21 Nov. 1886. At the age of two he was taken by his father to St. Petersburg; in 1815 went with his mother thence to Paris; the same year his father was made minister to England, and he was placed in an English

boarding-school. In 1817 both returned to America; he was placed in the Boston Latin School, and in 1825 graduated at Harvard. His father had just been inaugurated President, and he spent two years in Washington; then returned to Boston, studied law with Daniel Webster, and was called to the bar in 1828, but never practised — engaging in literature and political writing in magazines and pamphlets, and editing John and Abigail Adams' letters (1840–1). He was Representative in the legislature 1841–4, State Senator 1844–6, as a Whig; heading the «Conscience Whig» wing, he edited the Boston *Whig*, 1846–8, was chairman of the Free-Soil Convention at Buffalo in 1848, and was nominated for Vice-President on the ticket with Martin Van Buren. In 1850–6 he edited John Adams' ‹Works› in 10 volumes. He joined the Republican party on its organization in 1855, and in 1858 was sent to Congress, and re-elected in 1860. In 1861 Lincoln sent him to England as minister, as his father and grandfather had been before him. But even their problems were trivial beside his, when the very existence of the Union perhaps depended on how far the English upper classes could drag the government in evasion of international obligations and covert help to the South. The seizure of Mason and Slidell on the Trent nearly precipitated war; the fitting out of cruisers to destroy United States commerce was put a stop to only after the escape of the Alabama (q.v.) in the face of Mr. Adams' representations, and his declaration to Earl Russell, then foreign secretary, that permitting the Laird rams also to leave Birkenhead was «war.» Napoleon III.'s persistent efforts to seduce the English government into a joint intervention in favor of the Confederacy had to be checkmated; and the rancorous hostility of one section and the coldness of the remainder of the best society made it a lonely and trying place, which for seven years he filled with a dignified resolution of immeasurable importance to his country. Returning to America in 1868, he was elected president of Harvard the next year, but declined: for several years, however, he was president of its board of overseers. In 1871 he was the United States representative on the board of arbitrators at Geneva to settle the Alabama Claims (q.v.); in 1872 he nearly obtained the nomination as Democratic-Independent candidate for the presidency, which Horace Greeley secured. In 1874–7 he edited the ‹Memoirs of John Quincy Adams› in 12 volumes.

Adams, Charles Francis (2d), American publicist, son of above: b. in Boston, 27 May 1835. He was graduated at Harvard in 1856, and served as a cavalry officer through the Civil War, rising from first lieutenant to colonel, and being brevetted brigadier-general at its close. Shortly becoming noted for ability in discussion of economic, political, and social questions, he was appointed railroad commissioner of Massachusetts in 1869; wrote ‹Chapters of Erie› (1871) in collaboration with his brother Henry, a series of papers on railroad accidents and on ‹The State and the Railroads› (1875–6) for the ‹Atlantic Monthly,› ‹Railroads, the Origin and Problems› (1878), ‹Notes on Railway Accidents› (1879), etc.; and 1884–90 was president of the Union Pacific Railroad Company. In 1892 he published ‹Three Episodes of Massachusetts History,› on the settlement of Boston Bay, the Antinomian controversy, and early town and church government, and in 1893 ‹Massachusetts: Its Historians and Its History.› In 1895 he was chosen president of the Massachusetts Historical Society, and in 1901 president of the American Historical Association. He has also written lives of Richard Henry Dana (1891) and of his father (1900, Am. Statesmen Series), ‹Lee at Appomattox,› etc. (1902), and much miscellaneous work. As chairman of the State Park Commission, 1893–5, he contributed materially toward planning out and establishing the great Metropolitan Park System of Massachusetts.

Adams, Charles Kendall, American historian and educator: b. Derby, Vt., 24 Jan. 1835; d. 26 July 1902. He removed to Iowa in 1855; graduated at the University of Michigan in 1861; became assistant professor there 1863–7, and professor of history 1867–85. He studied abroad 1867–8; in 1869–70 introduced the German seminary method into the United States by establishing the Historical Seminary in the University of Michigan; and was made dean of its School of Political Science when established. In 1885 he succeeded Andrew D. White as president of Cornell; resigned 1892, and till 1902 was president of the University of Wisconsin. He was chief editor of ‹Johnson's Universal Cyclopædia,› 1892–5. His most valued work is a ‹Manual of Historical Literature› (1882); he wrote also ‹Democracy and Monarchy in France› (1872); ‹Christopher Columbus› (1892); compiled ‹British Orations› (1884); and wrote much magazine and review matter.

Adams, Charles R., American tenor: b. Charlestown, Mass., 1848; d. 1900. He studied in Vienna, sang three years at the Royal Opera in Berlin, and nine in the Imperial Opera at Vienna. He was highly reputed as an interpreter of Wagnerian parts. In 1879 he settled in Boston, where he taught with great approval.

Adams, Edwin, American actor: b. 1834 in Massachusetts; d. in Australia, 1877. He first appeared as Stephen in ‹The Hunchback› at the Boston National Theatre, 29 Aug. 1853: played Hamlet at Wallack's (N. Y.) in 1860; starred in other cities, and returned to New York in 1866 as Robert Landry in ‹The Dead Heart›; was one of Booth's company when he opened his theatre 3 Feb. 1867, and played Mercutio and Iago, but won most fame as Enoch Arden.

Adams, Frank Dawson, geologist: b. Montreal, Can., 17 Sept. 1859; graduated at McGill University in 1878; took advanced courses at Sheffield Scientific School (Yale), and at Heidelberg, applying himself particularly to lithology and physical geology; in 1888 became lecturer on geology at McGill, and in 1893 succeeded Sir William Dawson as Logan professor of geology there.

Adams, George Burton, American historical writer: b. Vt. 1851. He is a professor of history at Yale; author of ‹Civilization During the Middle Ages› (1883), and ‹The Growth of the French Nation.›

Adams, Hannah, American literary pioneer: b. Medfield, Mass., 1755; d. 15 Nov. 1832. Her principal works were an ‹Autobiography›; ‹History of New England› (1799);

‹History of the Jews› (1812); besides several writings on religious topics. She lived in Brookline, Mass.

Adams, Henry, American historian, son of Charles Francis: b. Boston, 16 Feb. 1858. He was private secretary to his father during the latter's English ministry, and assistant professor of history at Harvard 1870–7, being reputed one of the most stimulating and original instructors as well as brilliant expositors in the country. With several pupils he published in 1876 ‹Essays on Anglo-Saxon Law,› of which he wrote on ‹Anglo-Saxon Courts of Law.› In 1871 he collaborated with his brother Charles Francis in ‹Chapters of Erie.› He edited the ‹North American Review,› 1875–6. In 1879 he published Albert Gallatin's writings (3 vols.); in 1882 a life of John Randolph (American Statesmen Series). But his life-work, and with one exception the foremost historical work of America in matter and style, is his ‹History of the United States from 1801 to 1817›—that is, the presidencies of Jefferson and Madison (9 vols. 1889–91): in motive a defense of his grandfather John Quincy Adams for deserting the Federalist party; in essence, a history of the causes and conduct of the War of 1812. For this he took up his residence in Washington and spent years ransacking its archives. He also lived for long periods abroad, examining various European records, and trained himself thoroughly in military and naval science and construction, besides studying historical and economic problems.

Adams, Henry Carter, economist: b. Davenport, Iowa, 31 Dec. 1852. He was graduated at Iowa College; afterward took a post-graduate course at Johns Hopkins, of which he became fellow and lecturer. Later a lecturer at Cornell, he is now professor of political economy and finance in the University of Michigan. He was statistician to the Interstate Commerce Commission, and had charge of the transportation department in the census of 1900. He has published works on public debts (1887), on taxation, political economy, industrial subjects, etc.

Adams, Herbert Baxter, historical student and educator: b. Shutesbury, Mass., 16 April 1850; d. 1901. He was graduated at Amherst in 1872; took Ph.D. at Heidelberg; and on the opening of Johns Hopkins in 1876 was made fellow in history, 1878 associate in history, 1883 associate professor in history, and in 1891, full professor. In 1901 he resigned on account of ill health, and died shortly after. In 1884 he was a leader in organizing the American Historical Association, and was secretary till 1900, then becoming first vice-president. He edited the ‹Johns Hopkins Studies in History and Political Science› from the start, also the ‹Contributions to American Educational History› published by the United States Bureau of Education. His chief publication is ‹The Life and Writings of Jared Sparks› (2 vols. 1893). Among his historical monographs are ‹The College of William and Mary,› ‹Thomas Jefferson and the University of Virginia,› ‹The Germanic Origin of New England Towns,› and ‹Maryland's Influence in Founding a National Commonwealth.› But his best work was not in writing history, but in training others to write it, and he was a powerful influence in creating the new school of historical research.

Adams, Isaac, inventor of the «Adams press» familiar to printers: b. in Rochester, N. H., 1803; d. 19 July 1883. He was a cotton-mill hand, then cabinet-maker, then machinist. His press—its essence consisting in the raising of the bed against a stationary platen instead of bringing the platen down on the bed—was patented in 1828, and much improved in 1834. He was a member of the Massachusetts Senate in 1840.

Adams, John, 2d President of the United States: b. Braintree, Mass., of a line of farmers, 19 Oct. 1735; d. July 4 1826, the year after his son was inaugurated President. Graduated at Harvard, he taught school, and read theology for a Church career; but seeing his unfitness for it studied law and began practice in 1758, soon becoming a leader at the bar and in public life. In 1764 he married his famous wife. All through the germinal years of the Revolution he was one of the foremost patriots, steadily opposing any abandonment or compromise of essential rights; and in 1766 published essays in the Boston *Gazette*, reprinted in London 1768, entitled ‹A Dissertation on Canon and Feudal Law,› really on colonial rights. In 1765 also he was counsel for Boston, with Otis and Gridley, to support the town's memorial against the Stamp Act. In 1766 he was a selectman, or in other words one of the three official rulers of the head of the New England colonies. In 1768 the royal government offered him the post of advocate-general in the Court of Admiralty,—in fact a lucrative bribe to desert the opposition; but he refused it. Yet in 1770, as a matter of high professional duty, he took his future in his hands to become counsel (successfully) for the British soldiers on trial for the «Boston Massacre.» Though there was a present uproar of abuse, Mr. Adams was shortly after elected Representative to the General Court by more than three to one. In March 1774 he was contemplating writing the ‹History of the Contest between Britain and America.› June 17 he presided over the meeting at Faneuil Hall to consider the Boston Port Bill, and at the same hour was elected delegate to the first Congress at Philadelphia (1 September), by the Provincial Assembly held in defiance of the government. Returning home, he was made a member of the Provincial Congress, already organizing resistance to England. Just after Lexington he again journeyed to Philadelphia to the Congress of May 1775; where he did on his own motion, to the disgust of his associates and the reluctance even of the Southerners, one of the most important and decisive acts of the Revolution,—induced Congress to adopt the forces already gathered in New England as a national army and put George Washington at its head, thereby engaging the Southern colonies irrevocably in the war and securing the one man who could make it a success. In 1776 he was a chief agent in carrying the Declaration of Independence. He remained in Congress till November 1777, serving on the Committee on Foreign Relations and as chairman of the Board of War and Ordnance, very useful and laborious, but making one dreadful mistake: he was largely responsible for the policy of ignoring the just rights and decent dignity of the military commanders, which lost the country some of its best officers and led ultimate-

JOHN ADAMS,

SECOND PRESIDENT OF THE UNITED STATES.

ly to Arnold's treason. His reasons, exactly contrary to his wont, were sound abstract logic, but thorough practical nonsense.

In December 1777 he was appointed commissioner to France to succeed Silas Deane. Dr. Franklin and Arthur Lee were there before him; and though he reformed a very bad state of affairs, he thought it absurd to keep three envoys at one court and induced Congress to abolish his office, returning in 1779. Chosen a delegate to the Massachusetts Constitutional Convention, he was called away from it to be sent again to France. There he remained as Franklin's colleague, detesting and distrusting him and the foreign minister Vergennes, embroiling himself with both, and earning a cordial return of his warmest dislike from both, till July 1780. He then went to Holland as volunteer minister, and in 1782 was formally recognized as from an independent nation. Meantime Vergennes intrigued energetically to have him recalled, and did succeed in tying his hands so that but for his contumacious stubbornness half the advantages of independence would have been lost, as Vergennes was employed to gain points for France and not for the United States. In the final negotiations for peace he persisted (against his instructions) in making the New England fisheries an ultimatum, and saved them. The wretched state of American affairs under the Confederation made it impossible to do his country any good abroad, and the vindictive feeling of the English made his life a purgatory, so that he was glad to come home in 1788.

In the first Presidential election of that year, he was elected Vice-President on the ticket with Washington; and began a feud with Alexander Hamilton, the mighty leader of the Federalist party and chief organizer of our governmental machine, which ended in the overthrow of that party years before its time, and had momentous personal and literary results as well. As official head of the party he thought himself entitled to its real leadership as well; Hamilton would not and indeed could not surrender his position, for the lesser men looked to him for counsel and policy, and the rivalry never ended till Hamilton's death. In 1796 he was elected President against Jefferson, and his term is recognized as one of the ablest and most useful of our administrations; but its personal memoirs are most painful and scandalous. The members of the Cabinet— nearly all Hamiltonians — laid official secrets before Hamilton and took advice from him to thwart the President. They disliked Mr. Adams' overbearing ways and obtrusive vanity,— for modesty or a low sense of personal dignity were no parts of his character,— considered his policy destructive to the party and injurious to the country, and felt that loyalty to them involved and justified a disloyalty to him. Finally his best act brought on an explosion. The French Directory had provoked a war with this country, which the Hamiltonian section of the Federalist leaders and much of the rank and file hailed with delight, thinking it a service to the world to cripple France as then ruled; but when it showed signs of a better spirit, Mr. Adams, without consulting his Cabinet (who he knew would oppose it nearly or quite unanimously), nominated a commission to frame a treaty with France. He had the constitutional right to do so; but the storm of fury that broke on him from the party has rarely been surpassed in the case of traitors outright, and he was charged with being little better. He was renominated for President in 1800, but beaten by Jefferson, owing to the defections in his own party, largely of Hamilton's producing. The Federalist party never won another election; the Hamiltonians laid its death to Mr. Adams, and American history is hot with the fires of this battle even yet.

His later years were spent at home, where he was always interested in public affairs and sometimes much too free in his comments on them; where he read immensely and wrote somewhat. He heartily approved his son's break with the Federalists (see ADAMS, JOHN QUINCY) on the Embargo (q.v.). He died on the same day as Jefferson, both on the 50th anniversary of the Declaration of Independence.

Mr. Adams' greatest usefulness and popularity sprang from the same cause that produced some of his worst blunders and misfortunes: a generous impulsiveness which which made it impossible for him to hold his tongue at the wrong time and place for talking, his vehemence, self-confidence, and impatience of obstruction. He was fervid, combative, opinionated, and masterful, and naturally won more hate than love; but he had trust, admiration, and respect from the majority of his party at the worst of times, and history justifies it. ('Works,' by his grandson Charles Francis Adams.)

Adams, John, American educator: b. Connecticut, 1772; d. 1863. Graduated at Yale in 1795, he was a school-teacher till 1810, and thence till 1833 principal of Phillips Academy, Andover, Mass., which he developed into repute throughout the country. He was teacher of Oliver Wendell Holmes, who, in the lines beginning «Grave is the Master's look,» commemorates him in his poem 'The School-Boy,' read at the Phillips Academy centennial in 1878.

Adams, John, Confederate soldier: b. Tennessee, 1825; d. 30 Nov. 1864. He was graduated at West Point in 1846; was brevetted first lieutenant for bravery at Santa Cruz de Rosales, 1848; promoted captain of dragoons, 1856; and resigned 1861 to join the Confederate army, in which he rose to the rank of brigadier-general. He was killed at the battle of Franklin, Tenn.

Adams, John, the name assumed by Alexander Smith, one of the mutineers of the Bounty. After intoxication and massacre had killed off all the mutineers but himself, he was shocked into a complete change of heart, and became sincerely pious and of upright life; he was the patriarch of the little native and half-caste group on Pitcairn's Island, taught a school and held worship there. It was nearly twenty years after the mutiny before his existence was known; and though technically liable to execution for the mutiny the English officials felt that his hardships, exile, and repentance had atoned for the crime, and that it would be wrong to remove the head from the little settlement. He was left unmolested and died in 1829. See BLIGH, WILLIAM; PITCAIRN'S ISLAND.

Adams, John Couch, English astronomer: b. in Cornwall, 5 June 1819; d. 21 Jan. 1892. A precocious mathematician, he became senior wrangler at St. John's College, Cambridge, and

mathematical tutor there. He discovered in 1845, by calculation of the perturbations of Uranus, that another planet must exist beyond it, and fixed its position within two degrees; but search for it not being made, Leverrier of Paris independently made the same discovery next year, and Galle of Berlin at once found the planet (see NEPTUNE). In 1851 he became president of the Royal Astronomical Society; 1858–9 professor of mathematics at Aberdeen University; 1859–92 Lowndean professor of astronomy and geometry at Camridge, and in 1861 director of Cambridge Observatory. He was a delegate to the International Prime Meridian Conference at Washington 1884.

Adams, John Quincy, 6th President of the United States, son of John Adams: b. in Braintree, Mass., 11 July 1767; d. Washington, D. C., 23 Feb. 1848. At 10 he accompanied his father on his first embassy to France, and was placed at school near Paris. He returned with his father in about 18 months; but soon went back with him to Europe, and attended school in Holland and at the University of Leyden. At 15 Francis Dana, his father's secretary of legation, who had been appointed minister to Russia, took him with him as his private secretary. After 14 months' stay in Russia, where Catherine refused to recognize Mr. Dana, he traveled back alone through Sweden and Denmark to The Hague. Soon after his father's appointment as ambassador at London in 1785, he returned home to complete his studies, as he believed « an American education to be the best for an American career,» a coolly judicious choice for a lad of 18. He graduated at Harvard in 1788, entered the office of Theophilus Parsons (q.v.), and in 1791 was admitted to the bar. He now began to take an active interest in politics. He wrote a series of letters to the Boston *Sentinel* under the signature of « Publicola,» in reply to Paine's « Rights of Man,» and in 1793 defended Washington's policy of neutrality under the signature of « Marcellus.» These letters attracted attention, and in 1794 Washington appointed him minister to The Hague. In 1798 he received a commission to negotiate a treaty of commerce with Sweden; and traveling through Silesia wrote an account of it which was published in London, and later translated into German and French. On Jefferson's accession to the presidency he was recalled and resumed law practice.

In 1802 he was sent to the State Senate; the next year to the United States Senate in place of Timothy Pickering, leading Hamiltonian. But the Hamilton-Adams feud (see ADAMS, JOHN) had split the party into rancorously hostile halves, and Mr. Adams was practically « boycotted » by the dominant section of his own party, as being an Adams, with an ingenuity of indecent insult curious to read of; still worse was it when Pickering was made his colleague by the other faction at the next vacancy. It was good training for the great career of his later life; he was not the man to conciliate his foes, and soon made the breach irreparable by breaking away from the party policy. Through life any action which strengthened the United States, or increased its dignity in the eyes of the world, or simply « showed fight » for any purpose, met with his heartiest approval and warmest support, even though fathered by his worst enemies; and he first supported (with some reservations) Jefferson's Louisiana purchase,— precisely in the line of the former Federalist policy and the nature of the party, but now fought by them as Jefferson's,— and in 1807 took a far more radical step. The action of France and Great Britain in plundering American commerce for evading their mutual blockade laws, and of the latter for impressing American citizens under pretense of their being English runaways, had enraged the country, but it was helpless against both and felt not strong enough at the time to fight either; finally the outrage of the Leopard on the Chesapeake (see the latter name) roused the Republicans to fury, and even many of the Federalists. But the leaders of the latter sympathized with England's difficulties in the war with Napoleon, would do nothing to embarrass her, and even defended the Leopard's action. Mr. Adams was as hot as any Republican; he tried to have the Boston Federalists hold a meeting and pledge the government their support in any measures to curb British insolence, and on their refusal attended a Republican meeting and was put on a committee to draft such resolutions. The Federalists were soon compelled by popular feeling to do likewise, and Mr. Adams also drafted resolutions there. At the extra session of Congress in October the Embargo on all American shipping was passed, to see if England could not be starved into better behavior; half ruining New England, most of whose capital was invested in commerce, and injuring Americans much more than the enemy. Mr. Adams was a member of the committee which reported the bill, and earnestly advocated it,— not because it went as far as he liked, but as preferable to showing no resentment whatever, and all the Federalists would permit. The execrations leveled at his father for the French mission, and the charges of sectional and party treachery, were repeated on the son; political literature for half a century was glowing with the acrid polemics on the subject, and the prime object of his grandson Henry Adams's ‹History› is to exculpate him. His term in the Senate was to expire 3 March 1809; in the preceding June the Massachusetts legislature elected James Lloyd to succeed him, as an insult, which he accepted and at once resigned. Meantime he had been made professor of rhetoric at Harvard and delivered lectures there. The next month he declined a Republican nomination to the House.

On Madison's accession in 1809 he at once appointed Mr. Adams minister to Russia; the Senate for some months refused to confirm the nomination, but at length yielded, and he pass 4½ years there. In the peace negotiations with England over the War of 1812, he was a commissioner with Gallatin and Bayard, and again defeated assaults on the American fishing rights like his father. The treaty is usually considered a humiliating fiasco for America; but it is significant that the British press considered it a surrender on their side, and especially reviled Mr. Adams for his share in it. Visiting Paris, he was made commissioner to negotiate the American-English commercial treaty signed 13 July 1815. Meantime he had arrived in England, 26 May, and received the news of

JOHN QUINCY ADAMS,

SIXTH PRESIDENT OF THE UNITED STATES.

his appointment as minister to that country. The synchronisms of wars, treaties, and ministerships between father and son is so curious that in ancient history it would be treated as indubitable confusion of persons.

Eight years later, after leaving America, Mr. Adams was recalled to it as Secretary of State under Monroe, inaugurated March 1817. His greatest achievement was the treaty with Spain ceding Florida to the United States for $5,000,000, to be used in paying American claims against Spain; and rectifying the boundaries of Louisiana and Mexico. His utter independence of personal against national considerations is singularly shown in his support of Jackson for invading Spanish Florida and hanging Arbuthnot and Ambrister; he hated and despised Jackson, and the latter had violated all international law; but he had roughly vindicated United States rights and put down dangerous intrigues with savages, and Mr. Adams vigorously defended him. He was the author of the « Monroe Doctrine,» and though he never dreamed of its later interpretations would not improbably have sympathized with them. He also drew up a report on weights and measures which is still a classic, and shows an almost incredible amount of investigation. An ultimately far more important question came up over the admission of Missouri as a slave State. The Missouri Compromise (q.v.) had been passed and put before Monroe for signature, but he submitted to his Cabinet the questions whether Congress had a constitutional right to prohibit slavery in a Territory, and whether the prohibition of slavery « forever » in the territory north of Mason and Dixon's Line meant while it remained a Territory or thereafter. The Cabinet was unanimous in the affirmative on the first question; Mr. Adams was alone in declaring that « forever » included statehood also.

In the presidential election of 1824 there was no electoral majority: Andrew Jackson had 99, Mr. Adams 84 (a remarkable vote considering his ungracious manner, gift for making enemies, and refusal to do anything to promote his election), William H. Crawford 41, and Henry Clay 34. Crawford was put out of the field by a paralytic stroke. As Clay could not be elected, his supporters cast their votes for Adams as preferable to Jackson: the former represented the same public policy as theirs, he was the ablest public official in the country and not personally hostile to Clay, while Jackson was regarded as an ignorant and violent demagogue. Mr. Adams was elected, and made Clay secretary of state, a place to which Clay's talents and position gave him almost a prescriptive claim. The Jacksonians denounced this as a corrupt bargain to defeat the people's will, and absurdly gave it the name of the unsavory English «Coalition,» a catchword which was an efficient party weapon for many years. Mr. Adams' administration had no dramatic events. Its policy was based on a new division of parties. The Federalists were dead, consequently their opponents were dead also, and the new division was into National Republicans, afterward Whigs, and Democratic-Republicans, or Democrats: the former favoring internal improvements, a national bank, and high tariffs, the latter opposing them. In reality, the division was between the preferences of the capitalist class and the masses. The Adams administration was Whig, and had the hostility of the Northern commercial classes whose trade the tariff was intended to cut down, and of the Southern planters who would lose as consumers while having nothing to protect as producers. Still more effectively the Jacksonian party, steadily and rapidly growing, used the promise of « spoils » to gain support; and in 1828 Mr. Adams was defeated for re-election by 178 to 83.

Mr. Adams retired, as he supposed, from public life. But in 1831 the constituency of his district around Braintree elected him a member of Congress on the Anti-Masonic ticket (see ANTI-MASONRY; MORGAN, WILLIAM); and though that party soon died, his immense ability and unique power in Congress kept him there till his death. By a singular fortune, he owes by far his greatest fame to this relatively small position after his crowning office was laid down. Belonging to no party, a political Ishmaelite, of the loftiest patriotism and the highest integrity, but scornful of nature and irritable in temper, rousing every demon of hatred in his fellow-members, in constant and envenomed battle with them and more than a match for them all, the « old man eloquent » was for many years a storm centre of wonderful picturesqueness. But his repute is not a mere political curio: he had the fortune to take his place at the very outset of the struggle of the slave oligarchy to suppress free speech and writing on the slavery question, and crush political liberty to uphold slavery. He fought the attempt unflinchingly year after year by purely legal methods, upholding the right of petition as indefeasible under any government or for any purpose,— he did not hesitate to submit a petition from Virginians praying for his own expulsion as a nuisance,— and consequently a right of slaves or of others in their interest; and with little sympathy for the anti-slavery cause as such, became by force of circumstances its mightiest champion. He died of a stroke of apoplexy on the floor of the House.

Adams, John Quincy (2d), American politician, son of Charles Francis; b. in Boston, 22 Sept. 1833; d. 14 Aug. 1894. He was graduated at Harvard in 1853, and became a lawyer. A Democrat after the war, he took hopeless candidacies for the governorship to keep the organization together, in 1867 and 1871, and for the vice-presidency in 1872. He also served in the legislature in 1866, 1869, and 1870. In 1877 he was made a member of the corporation of Harvard.

Adams, Julius Walker, American civil engineer: b. in Boston, Mass., 18 Oct. 1812; d. 13 Dec. 1899. Took part of the course at the United States Military Academy; was engaged for many years on railroad and waterworks construction, and planned the sewerage system of Brooklyn, N. Y.; was colonel of the 67th N. Y. Vols. in the Civil War; and was the pioneer engineer of the East River bridge.

Adams, Maude Kiskadden, American actress: b. in Salt Lake City, 11 Nov. 1872; daughter of an actress who was leading woman of a stock company in that city, under the stage name of Adams. At 16 Miss Adams joined

E. H. Sothern's company in the ‹Midnight Bell›; afterward she was in Charles Frohman's stock company, and later supported John Drew. She made a great success in J. M. Barrie's ‹Little Minister› in 1898, as Lady Babbie, and in 1900 as the Duc de Reichstadt in Edmond Rostand's ‹L'Aiglon.› She played Juliet in 1899, and Miss Phœbe in Barrie's ‹Quality Street› in 1901.

Adams, Nehemiah, American Congregational clergyman: b. in Salem, Mass., 19 Feb. 1806; d. 6 Oct. 1878. He graduated at Harvard in 1826, and at Andover Theological Seminary in 1829. The same year he settled at Cambridge, but 1834–70 was pastor of the Essex Street Church in Boston, and was widely reputed for his eloquence and learning. He published several polemic works; the most sensation was created by ‹A South Side View of Slavery,› published in 1854 after a winter in Georgia, in which he lauded slavery as beneficial to the negroes' religious character.

Adams, Parson (Abraham), one of the heroes of Fielding's ‹Joseph Andrews,› and the only creditable character in it except the heroine. He is a huge-framed, simple-souled, great-hearted, utterly disinterested innocent, a brother of Don Quixote, Colonel Newcome, and Uncle Toby.

Adams, Samuel, American patriot: b. Boston, 27 Sept. 1722; d. 2 Oct. 1803. He was son of a rich merchant, ship-owner, and magistrate, a leader in provincial contests with royal governors, and inventor of the caucus in fact and perhaps unintentionally in name. Educated at the Boston Latin School, he graduated at Harvard in 1740. In 1743 he wrote for his master's degree a thesis upholding the lawfulness of resisting supreme magistrates. He became a lawyer; but the profession was under ban with the upper classes, and at his family's wish he entered a leading merchant's counting-house. Shortly afterward his father set him up in business, in which he lost half his capital, losing the other half by a loan never repaid. Then he became partner with his father in a rather unsuccessful brewery. Soon the father lost nearly all his property in a land-bank scheme crushed by an act of Parliament, which extended an English banking enactment to the colonies. The hundreds of ruined shareholders denounced this act as an invasion of chartered colonial rights, and it turned the cream of the business leaders of Massachusetts, and their sons and daughters, into potential rebels at a blow. On his father's death in 1748 he carried on the brewery alone, and was nicknamed by his opponents «Sammy the maltster,» changed to «Sammy the publican» when he was made tax-collector of Boston 1763–5. Meanwhile he had become a great power in town meetings, having strong and sincere democratic feeling and a marvelous genius for political management and «caucusing.» As collector he was a bad business manager and was sharply assailed; but his political headship is shown by his being selected in 1764 to draft the town's instructions to its representatives relative to the Stamp Act,— the first public American protest against the parliamentary right of taxation,— and the like instructions the next year. He was himself in the legislature 1765–74, being clerk of the House and on the leading committees, drawing up the most important state papers of that stormy time, and spokesman as well as prompter of the incessant wrangles with Govs. Bernard and Hutchinson. When the Townshend Acts were passed in 1767, he drafted the legislature's petition to the king, the instructions to the Massachusetts agent in England, and the circular letter of February 1768 to the other colonies asking their aid. The latter led directly to the Revolution, George III. ordering Bernard to command the legislature to rescind it or be instantly dissolved. The latter refusing by 92 to 17, the king thereon resolved to send troops to overawe the colony. The same year Adams wrote ‹The True Sentiments of America,› and in 1769 a famous ‹Appeal to the World.› The morning after the «Boston Massacre» he was made chairman of a committee to communicate to Gov. Hutchinson and his council the town-meeting vote that the two regiments of British soldiers should be removed to the castle in the harbor. When the governor wished to compromise on one, Adams had the people insist on «both or none,» and both were removed, thereafter being known in Parliament as the «Sam Adams regiments.» In 1772 the order was issued that the judges should thereafter be paid by the Crown, not by the colony, and be removable at the king's pleasure: the Boston town-meeting requested Gov. Hutchinson to convene the legislature on the question, and on his refusal Mr. Adams revived a proposal of Jonathan Mayhew's in 1765, to have the towns of Massachusetts appoint committees of correspondence to consult about the common weal. Eighty towns soon adopted the suggestion, forming an omnipotent revolutionary legislature beyond the reach of government veto or dissolution, yet quite within the law. The next spring intercolonial committees of the same sort were formed,— an unorganized government of the united colonies. Meanwhile Mr. Adams had kept the public spirit inflamed and alive to the nature of the crisis by articles under various pseudonyms in the Boston *Gazette,* arguing the colonists' legal rights and the practical impossibility of any compromise; thus not only preparing the public for the crisis and bringing over the waverers, but making the crisis itself more inevitable. The management of the tea-ship matter was in the hands of the committees of correspondence of Boston and five adjoining towns, of which Mr. Adams was the active head; and the throwing of the tea into the harbor, 17 Dec. 1773, was unquestionably supervised or arranged by him. When as a punishment the port of Boston was closed and the charter of Massachusetts annulled in April 1774, and the legislature met at Salem under parliamentary order to abase itself and undo its bad work, Mr. Adams locked the door, pocketed the key, and carried through the measures for calling a congress at Philadelphia in September; the legislature adjourned *sine die* while the governor's clerk was hammering at the door with the writ of dissolution, and British authority was at an end. Mr. Adams' lifework — of assuring the breakdown of a system difficult to work at best, the government of a country by scornful aliens plus the aristocratic native families — was over. Though a useful and upright public servant, he was of secondary importance in presence of large problems of constructive statesmanship: his abilities were parochial, and

he does not figure on a national scale. He could manage caucuses and organize jealousies, but hardly frame constitutions. At the Philadelphia Congress he was of course a delegate, and greatly smoothed over sectional distrusts by his shrewdness, tact, and geniality. In 1775 he and Hancock were the only patriots excepted from amnesty; and it was Gage's attempt to seize them — under government orders, and with London forecasts that their heads would soon adorn Temple Bar — that brought on the battle of Lexington and opened the Revolutionary War. They escaped by Paul Revere's warning. He led in pushing forward the Declaration of Independence, of which he was one of the signers; and was active in Congressional work till the close of the Revolution. With much creditable service, his sympathies were always with division of authority; he believed in committees instead of executive heads, and national policy was often affected disastrously by the delays and irresponsibility involved. He was largely instrumental in framing the State Constitution of 1780. Nationally, he was of course an Anti-Federalist, opposing a strong national government in fear of tyranny: after long hesitancy over supporting the Constitution of 1787, he did so only on the understanding that amendments constituting a bill of rights should be submitted; but his voice in favor of ratification by Massachusetts secured it by 187 to 168, and saved it to the nation. He was long on the Executive Council of Massachusetts, lieutenant-governor 1789–94, and governor 1794–7 (three terms).

Adams, Suzanne, American lyric soprano: b. Cambridge, Mass., 28 Nov. 1873; studied with Marchesi at Paris: made her début 1894 at the Opera, as Juliet in Gounod's «Romeo and Juliet.» After three years there she went to Nice, then to Covent Garden in London, then (1898–9) to the Metropolitan Opera House, New York. She married Leo Stern the violoncellist in 1899. She has sung in many operatic soprano parts.

Adams, William, the first Englishman in Japan: b. Kent, c. 1575. In 1598 he sailed as pilot of five Dutch vessels from the Texel to the East; landing at Kiushiu, the great Shogun Iyéyasu, who had shortly before crushed his rivals and ended Japan's feudal anarchy, first imprisoned and then took him into service, employing him in shipbuilding, as informant, etc. In 1613 other Englishmen came on the Clove, and with Adams started a factory at Firando, of which Richard Cocks was chief. Iyéyasu dying in 1616, a reaction against foreigners set in, and Adams wished to return to England, where he had left a wife and children; but was forbidden, and married a Japanese wife, their descendants still living in Japan. He died 16 May 1620. "Pilot Street" in Yedo (Tokio) was named after him.

Adams, William Henry Davenport, English journalist and critic: b. 1851; d. London 27 July 1904. He published 'A Dictionary of English Literature' (1878); 'The Witty and Humorous Side of the English Poets' (1880); 'By-Ways in Bookland' (1888); 'A Book of Burlesque' (1891); 'With Poet and Player' (1891).

Adams, William Taylor, American author and editor, best known by the pseudonym "Oliver Optic": b. Medway, Mass., 30 July 1822; d. 27 March 1897. He taught for many years in the Boston schools. He was a voluminous and highly popular writer of fiction for young readers, his works including over 100 volumes, mainly travel and adventure: 'Young America Abroad,' 'Starry Flag Series,' and others.

Adams, Mass., town in Berkshire County, containing villages of Adams (formerly South Adams), Maple Grove, Zylonite, and Renfrew; the first and chief 16 m. N. of Pittsfield, 6 m. S. of North Adams, which was set off in 1878; on Pittsfield & N. A. branch of the Boston & A. division of the New York Cent. R.R. It is on Hoosac River, and contains Greylock Mountain, the highest point in Massachusetts. Founded in 1749 as East Hoosuck, it was renamed for Samuel Adams 1778. Manufactures, paper, foundry work, fabrics, etc. It has a public library and a town board of three selectmen. Pop. (1900) 11,134.

Adams Family, of Massachusetts. In the varied abilities and conspicuous public importance of its members, this family confessedly outranks every other in the United States. It has furnished in a single line two Presidents, both of great weight and permanent importance, and even more interesting as virile and individual characters, provoking admiration or hate, but never indifference; a statesman and a diplomat of high order; the author of one of the two first-rate histories yet written in America, matter and style both considered; a noted financier and business magnate, and prominent author as well; another keen and vigorous writer; and an able lawyer and local politician who might have attained larger importance but for belonging to a party in a hopeless minority in his State. The founder in America was Henry Adams, an Englishman with eight sons, who removed to Braintree, Mass., in 1636; but the fortunes of the family began when to this tough stock — in the person of John Adams, who died in 1760, a selectman of Braintree and a deacon, and a farmer almost a rich man for the times — was added the energetic, passionate Boylston blood, a strain commemorated in Boylston Street, Boston, and the town of Boylston, Mass. The son of John Adams and Susanna Boylston was President John Adams (q.v.), the real founder of the family greatness and its striking individuality. All its members since have been distinguished by the same general qualities in varying mixture. They have mostly been vehement, proud, pugnacious, and independent, with hot tempers and strong wills; but with high ideals, dramatic devotion to duty, and the intense democratic sentiment so often found united with personal aristocracy of feeling. They have been men of affairs first, with large practical ability, but with a deep strain of the man of letters which in this generation has outshone the other faculties; strong-headed and hard-working students, with powerful memories and fluent gifts of expression. But no curio of heredity in all time is stranger than the contrast between the President father and his President son, John Quincy Adams (q.v.), when it is remembered that to the fiery, combative, bristling Adams-Boylston blood was added an equal strain from the gay, genial, affectionate Abigail Smith (see ADAMS, ABIGAIL). The son, though of deep inner affections, and even hungering for good will if it would

come without his aid, was on the surface incomparably colder, harsher, and thornier than his father, with all the socially repellent traits of the race and none of the softer ones. The father could never control his tongue or his temper, and not always his head: the son never lost the bridle of either, and much of his terrible power in debate came from his ability to make others lose theirs while perfectly keeping his own. The father had plenty of warm friends and allies — at the worst he worked with half a party: the son in the most superb part of his career had no friends, no allies, no party except the group of constituents who kept him in Congress. The father's self-confidence deepened in the son to a solitary and almost contemptuous gladiatorship against the entire government of the country through long years of hate and peril. The father's irritable though generous vanity changed in the son to an icy contempt or white-hot scorn of nearly all about him. The father's spasms of acrimonious judgment steadied in the son to a constant rancor always finding new objects. The country has reason to be thankful for his unamiable traits, for each one strengthened his fibre to do the work awaiting him, and only John Quincy Adams could have accomplished the work of John Quincy Adams. His son, Charles Francis Adams, Sr., had the useful and forcible qualities of both without their besetting defects. He was in youth as hotly pugnacious as his grandfather; he was always as self-centred as his father, and as willing to stand alone amid hate and incessant conflict: but he had far more self-control than the former, and far less bristling repellence and contempt of co-operation than the latter. His diplomacy was cast in a spot where he was too much «boycotted» to make the softer side of much avail: but he roused no useless and costly hatreds, and ranked the peer in effectiveness of any European diplomat. Of his living sons (see CHARLES FRANCIS, 2D; HENRY; BROOKS) it would be invidious to analyze the personal traits. The former, soldier, railroad commissioner, president of the Union Pacific Railroad, and present historical scholar and publicist, has shown the family traits of courage, independence of thought and action, and intellectual energy, to the full, and is still an active public force. The historian was distinguished during his historical professorship as the most original, independent, and stimulating of instructors; and his history displays not only massive research, enormous power of acquisition in the most widely separated fields, and entire freedom from beaten roads and traditional views, but tempered self-control, the moderation of judgment bred by thorough knowledge, and a pervasive atmosphere of gentlemanly irony. The essayist, assailant of the Massachusetts «theocracy,» and student of economic history to saturation, is as eager and passionate as his great-grandfather, and in striking contrast with his brothers in literary style, but none the less a man to reckon with. The late John Quincy 2d would perhaps have filled a larger public field in a less strongly Republican community. It is not likely that this virile stock has lost its energy with the present generation.

This by no means, however, ends the contributions of the Adams stock to our public life. The patriot, Samuel Adams, the father of American liberty, was own cousin to John Adams the President: a more dexterous and politic man, and much abler political manager, but not otherwise cast in as large mold. From different sons or grandsons of the pioneer have descended William Taylor Adams («Oliver Optic»), the well-known juvenile writer; Charles Baker Adams, the naturalist, and Edwin Adams, the actor, the grandfather of the first being the great grandfather of the second; Herbert Baxter Adams, the eminent American historical scholar and educator, and promoter of the higher historical methods in America; Alvin Adams, the founder of the Adams Express Company; William Claflin, the distinguished Massachusetts merchant and governor, whose mother was an Adams; and many other strong but lesser figures in public and private life.

A'damsite, a variety of the mineral muscovite (q.v.).

Adamson, Patrick, Scotch prelate (real name was spelled Constyne, Constean, Conston, Constant, and Constans; later changed to Constantine, then to Adamson): b. Perth, 15 March 1536; d. 19 Feb. 1592. He took his degree at St. Andrews, and in 1566 went to Paris as tutor. Here he wrote a Latin ode on the birth in June of James VI., and called him «king of France and England,» for which the French court gave him six months' imprisonment. Released, he went to Padua, Geneva, and Paris, and finally to Bourges, where he lay in hiding for seven months in fear of the rage against Protestants let loose by the massacre of St. Bartholomew (1572), and which cost his host's life. Recalled to Scotland (in 1573), he became a prominent minister, one of the commissioners to settle Church matters, and chaplain to the regent Morton, who in October 1576 made him archbishop of St. Andrews. The tragedy of his life lay in his attempting to be an old-fashioned prelate in the new Scotland which hated prelacy, and to air High-Church preferences before men who considered them popery. He began the warfare himself by declaring that he would oppose all attempts to deprive the archbishopric of any of its former power; the presbytery took up the glove, and never ceased till they had pulled him down. He was assailed first for not having been consecrated to his post; making his peace somehow for this, they again attacked him for insolence to the presbytery, for opposing its interests in Parliament, for popery, and heresy. The conflict grew so hot that he retired to the castle of St. Andrew's, where he was cured by a «wise woman» of a disease the doctors could not handle, and the presbytery afterward seized and burnt her for it. In 1583 he went to England as James' ambassador, exciting attention by his eloquence, and being savagely libeled by the Presbyterians for alleged looseness of behavior. Returning next May, he was high in favor with James, and his chief agent or prompter in severe measures against the Puritans. In December 1585 he published a paper on the «King's Majesty's Intent in the Late Acts of Parliament,» which was a chief article in his derelictions then, but in 1646, in the heart of the Civil War, was reprinted by the Puritans as on their own side. In 1585 Andrew Melville and other Presbyterian leaders returned after the Raid of Ruthven (q.v.), and that party was gaining the upper

hand: Morton had been executed in 1581. In April 1586 Adamson was impeached and excommunicated; the next year the excommunication was removed, but in 1588 he was freshly accused,— among other things, of mutilating and abstracting registries,— and the king, tired of the quarrel or convinced that it was Adamson's fault, transferred the revenues of his see to another party and left him in actual want for himself and family. A small pension was afterward granted him, but he died poor and wretched.

Adamson, Robert, Scottish philosophical writer: b. 1852; d. 1902. He was professor of philosophy at Owens College, Victoria University, Manchester, England. He wrote 'The Philosophy of Science in the Middle Ages' (1876); 'On the Philosophy of Kant' (1879); 'Fichte' (1881).

Adana, an ancient town in the S.E. of Asia Minor, capital of Adana vilayet, on the Sihun, about 25 m. from its embouchure in the Mediterranean, and about 30 m. from its port Mersina, with which, and with Tarsus about half way between, it is connected by railway. Pop. 45,000.

Adanson, å-dän-sōṅ, **Michel,** French naturalist and traveler (of Scottish extraction): b. 7 April 1727; d. 3 Aug. 1806. Although he gave much time and attention to the study of the sciences, particularly electricity, his chief work was in the realm of botany. From 1784 he spent five years in Senegal and collected a large number of plants and animals which he classified and described. His more important works are: 'Histoire Naturelle du Sénégal' and 'Familles des Plantes,' in which he opposed the system of Linnæus.

Adansonia. See Baobab.

Adaptation, the power and process of gradual change in an organism to fit it to changing conditions of environment. See Biology; Evolution.

The initial causes of life and evolution are motion and change of condition or environment. Whether there is a principle of life or a special impelling life-giving force or not, or whether what we call life is only a mode of being, we can easily perceive and realize that life is a relation, a process, and a process of adaptation or adjustment to the environment both physical and biological. Adaptation is a fundamental fact in the material universe; the different cosmical realms are interrelated in their action, and the harmony existing in the movements of the heavenly bodies have excited the wonder and admiration of mankind from the time when man walking erect could look toward the heavens and perceive the stars and guide his course by them. So also in the beings endowed with life. The adaptation of the living world to the environment is a universal fact. The individual members of each species of plant and animal are perfectly adapted to their surroundings. Though the individual may suffer or perish, in the long run the death of individuals does not disturb the harmony existing throughout nature, which has attracted the attention of observers and naturalists from the earliest times. It should be observed that plants and animals often have structures or habits which are not adaptive, but this is an exception to the rule, and does not interfere with the general course of nature.

By the terms environment, surroundings, conditions of life, medium or *milieu*, or *monde ambiant,* we mean the nature of any region or area on the earth's surface stocked with plants and animals. The nature of the earth's surface, of the soil, of well-watered regions, of deserts, plains, or barrens, the physics of the air and sea, are taught in our text-books of physical geography. Each such area is inhabited by assemblages of living beings adapted to such or such conditions or to such a climate, whether dry or humid, hot or cold. We speak of alpine or arctic life, of the flora and fauna of deserts, of mountains, of lowlands, of the great plains, of forests, of the coasts and abysses of the sea. The word « fauna » means the assemblage of animals inhabiting any area, as the word « flora » is used for the plants. Now each of these areas, with its peculiar surface features, climate, soil, etc., is characterized by a set of plants and animals perfectly adapted to it, and which flourish better there than in adjoining regions.

The most successful groups of animals, considered numerically, are the insects and the birds, which have become adapted for a life in the air, for flying, where they are more or less out of reach of their creeping enemies. Adaptation to this or that mode of life has been the cause of variability. Every species is adapted to its special niche or habitat.

The most remarkable cases of adaptation to extreme conditions of life are seen in animals living in the darkness of caves, or in the dark abysses of the sea, or parasitic animals, as the fluke and tapeworm, the root-barnacles (*Sacculina*), the fish-louse (*Lernæa*), and many insects. In all these forms the body has, as the result of a parasitic life, undergone profound modification, becoming so atrophied in certain respects as to present the utmost contrast to their free-living allies. Adaptation is continually correlated with certain given conditions. If the conditions be changed, in time the organisms, unless they are modified and changed to what we call new species, become inadapted, unfit for the new environment, and unsuccessful in the struggle for existence.

Extinct species are such unfit, inadapted forms. However well adapted they were at the period in which they lived, when the conditions of existence changed: when the climate changed from warm to cold, or the reverse; when the soil changed its elevation above the sea, or degree of dryness or humidity; when one area subsided, and another became elevated,— certain species or groups of species, unless they migrated, or were plastic enough to undergo modification and become what we call « new » species or « new » genera, unable to resist the change, died out,— became extinct. It is the harder parts of these extinct species which we find in the rocks and call « fossils.» They are the relics of former worlds, witnesses of the profound changes in physical geography through which our planet has passed. If we examine these fossil shells, and the remains of the hard parts of insects, the bones of reptiles, birds, mammals, or whatever they are, we perceive no imperfection, no half-formed organs, no signs of decay. We see no reason why they were not in their lifetime as species perfectly adapted to their environment. But living in a changing world, they became

useless, cumbered the ground, and had to succumb in the struggle for existence, and make way for those forms better adapted to the new conditions environing them.

But extinction has not been thoroughgoing and complete. A few ancient primitive forms have persisted and are still flourishing. Such are many of the *Protozoa* (*Saccamina* and others), the *Lingulella* and *Lingula, the* king-crab (*Limulus*), the *Peripatus* and *Scolopendrella*, which are probably the ancestral forms of insects; among the fishes the Australian lung-fish (*Ceratodus*), and among lizards the *Hatteria* of New Zealand. These forms, by reason of their astonishing vitality, have withstood the most widespread and the profoundest geological changes, but they are exceptional forms. On the other hand there were a vast number of species which were plastic enough to yield to the changes in their surroundings and became modified into new species adapted to the new conditions of existence. It is undoubtedly the case, then, that certain forms became inadapted and suffered extinction, though all through the ages the plant and animal census by no means became at any time lessened, but rather gradually increased in extent. Another fact clearly established is that the earlier forms were generalized and the later were specialized, and the former, the ancestors of the present species, had to make way for their more specialized descendants. Thus the trilobites were succeeded by the king-crabs, the creeping dinosaurs were succeeded by the flying reptiles or pterodactyls, and the highly generalized tailed *Amphibia* yielded the right of way to the tailless frogs and toads of the present day. Adaptation, then, is the process of modification of organisms caused by changes in the conditions of life. See also EVOLUTION; SPECIES.

Adar, Jewish month, 12th of the ecclesiastical and 6th of the civil year; representing parts of February and March of ours. The 7th was a fast for the death of Moses, the 9th for the falling-out of Hillel and Shammai. But the important days were the 13th, a fast in commemoration of that of the Jews for their threatened destruction by Haman (see ESTHER), followed by a feast on the next two days for their escape.

Adar'ce, a-där'sē, a salty deposit found on the grasses and sedges growing in wet places in ancient Galatia. It is used somewhat for cleansing the skin in cases of leprosy.

Adda (ancient Addua), a river of north Italy, descending from the Rhætian Alps, falls into Lake Como, and leaving this joins the Po after a course of about 170 miles.

Addams, Jane, American philanthropist: b. Cedarville, Ill., 6 Sept. 1860. Graduated at Rockford College in 1881, after post-graduate studies in Europe and the United States she became an active social reformer. She inaugurated in 1889 at Chicago the establishment known as Hull House, an adaptation of the « social settlement » plan to Chicago conditions. She has acted as street-cleaning inspector in Chicago, and has lectured on the improvement of the condition of the poor in great cities; and for executive power, practical rationality, and unselfishness is one of the leaders of American social reform. See SOCIAL SETTLEMENTS.

Addax, or **Addas** (Lat., of African origin), a North African antelope (*Addax nasomaculatus*), related to the oryx and similar to it in habits. Its large broad hoofs fit it for traveling over loose shifting sand; it has a long tail, long ears, and spirally-twisted horns three to four feet high. The animal measures about three feet in height at the shoulder; in color it is nearly white, with shading of reddish brown on the head and front of the body. The hoofs are black and there is a black, shaggy marking on the forehead above a white blaze on the nose. It is now becoming very rare in all parts of the Sahara. The Arabs hunt the adax with greyhounds.

Adder (Anglo-Saxon *nædder*, Goth. *nadro*, Ger. *natter*, a snake), a colloquial name for several poisonous snakes, mostly belonging to the family *Viperidæ*, such as the copperhead, moccasin, asp, etc.; and also for certain harmless snakes of the family *Colubridæ*, particularly the spreading adder (*Heterodon platyrhinus*), which when angry resembles the poisonous snakes. (See HOGNOSE.) In England the name denotes the only venomous snake of Great Britain,— the European viper (*Pelias berus*). See COPPERHEAD; DEATH-ADDER; PUFF-ADDER; VIPER; etc.

Addicks, John Edward, American capitalist: b. Philadelphia, 21 Nov. 1841; became wealthy and prominent first as a flour merchant, then as a gas manufacturer, organizing and becoming president of the Bay State Gas Co. of Boston in 1884, and buying control of the Brooklyn (N. Y.) Gas Co. in 1892. For eight years (1895–1903) he has been of national prominence as candidate for the United States senatorship from Delaware, which he has not succeeded in obtaining, but till recently he has been able to prevent the election of any rival, leaving first one and since 1901 both of Delaware's two seats vacant. The details are: In 1895 his rival was H. A. Du Pont; among the members of the legislature voting was the former speaker of the Senate, now governor through the death of Gov. Marvel: the Democrats and Populists declared his vote illegal, and refused to seat Du Pont. In 1896 the Republican State Convention to elect delegates to the St. Louis National Convention split and elected two sets, Du Pont and Addicks: the former were recognized as « regular » by the St. Louis Committee on Credentials, and the other section called themselves Union Republicans. In 1899 a successor to Senator Gray was balloted for, but there was no election. In 1900 as in 1896 two sets of delegates went to Philadelphia, and this time the committee seated the Addicks party; though he was thus recognized as State party chief, the 1901 election for senator was again a stalemate, and as there were two to elect, the State was left entirely unrepresented in the Senate. In the session of 1903 Addicks nominally withdrew, and a coalition of the Regular and the Union Republicans elected two Senators, a Regular for the short term and a Union for the long term.

Adding-Machine. See CALCULATING-MACHINE.

Addington, Henry, VISCOUNT SIDMOUTH, English statesman: b. 30 May 1757; d. 15 Feb. 1844; educated at Winchester and Brasenose

College, Oxford; he then studied law, and, through the influence of Pitt, entered Parliament (1784); was speaker of the House of Commons (1789–1801); chancellor of the exchequer and first lord of the treasury; he put through a bill disqualifying clergymen from sitting in the House of Commons, and later, with Pitt's advice, negotiated (1802) the Peace of Amiens, a cessation of war much needed by England. In 1805 he was raised to the peerage. As home secretary (1812–22), he was strict in his administration of justice and in conservative oversight of the press and public meetings. Partly due to his too great zeal was the "Manchester massacre." He resigned in 1824, owing to his disapproving of the recognition of the independence of Buenos Ayres.

Addison, Joseph, English essayist, son of Rev. Lancelot Addison, subsequently dean of Lichfield: b. at his father's rectory, Milston, Wiltshire, 1 May 1672; d. 17 June 1719. At 11 he was sent to the Charterhouse, where he made the acquaintance of his friend and future collaborator Steele. At 15 he proceeded to Oxford, entering first at Queen's College, but two years later being elected to Magdalen College for skill in Latin versification. He took M.A. in 1693, and held a fellowship in his college from 1699 to 1711. He had contemplated entering the clerical profession, but was diverted from his purpose by his literary tastes and by the early patronage he received from some of the greatest statesmen of the Whig party. Addison had the good fortune to secure as his earliest patron the poet Dryden. With sympathetic appreciation of Dryden's skill as a translator of classical poetry, the young scholar addressed to him some complimentary verses, which the poet approved of and inserted in his ‹Miscellanies› in 1693. A translation of the fourth «Georgic,» with the exception of the story of Aristæus, by Addison, appeared in the same collection in 1694, and he subsequently translated for it two and a half books of «Ovid.» A still higher honor was conferred on Addison by Dryden in prefixing his prose essay on Vergil's «Georgics» to his own translation of that poem, which appeared in 1697. Addison published in 1694 «An Account of the Greatest English Poets,» a running criticism in verse, which he dedicated to his fellow-student, the afterward celebrated Dr. Sacheverell. It is said to be chiefly notably for the ignorance, common to the day, which it displays of early English poetry.

Through the introduction, it appears, of Congreve, Addison early secured an able and powerful patron in Charles Montague, afterward Earl of Halifax, and in 1695 his own pen secured a greater in Lord Somers. He dedicated to this nobleman, then lord-keeper, a poem on one of King William's campaigns, and received as his reward a pension of £300 to enable him to travel in order to fit himself for the service of the king. In 1699, in which year appeared a collection of his Latin poems in the second volume of the ‹Musarum Anglicanarum Analecta,› he left England, and after spending more than two years in France and Italy was returning home through Switzerland when he was instructed to repair as envoy to the quarters of Prince Eugene, then engaged in an Italian campaign. The death of King William in March 1702 cancelled this appointment with the overthrow of his friends. He says, indeed, that he never received more than a single year's payment of his pension, and had to defray the expenses of his travels himself. Nevertheless he was able to extend his tour to Germany and Holland, and returned to England at the close of 1703, having attempted without success to procure an appointment as a traveling tutor.

During his residence abroad his pen had not been idle. His tragedy of ‹Cato› is supposed to have been written, subject to after revision, during his stay in France. During his journey across Mount Cenis he wrote his «Letter from Italy,» esteemed the best of his poems, and in Germany his «Dialogues on Medals,» which was not published till after his death. His ‹Remarks on Several Parts of Italy in the Years 1701–03› was published in 1705. It is an impersonal record of impressions in which current events have hardly any place, the absorbing topic being the correspondences traced between passages in the Latin poets and the scenes it illustrates. It was dedicated to Lord Somers. The first ministry of Queen Anne was a coalition one, in which the Whigs had still considerable power, chiefly due to the victories of Marlborough. Godolphin mentioned to Halifax his desire to have the achievements of the great commanders celebrated in appropriate verse. Halifax strongly recommended Addison, and the commission was at once assigned to him, and he produced the «Campaign,» which was about as good as a poem made to order by a man of taste and scholarly accomplishments, who was not quite a poet, could be expected to be. Before it was half finished Godolphin's approval was expressed in the form of an appointment to succeed Locke as a commissioner of appeal on excise. One official appointment succeeded another till the fall of the ministry, whose favor he had now made, in 1710. In 1706 he became under-secretary of state to Sir Charles Hodges, next year he accompanied Lord Halifax as his secretary on a mission to the Elector of Hanover. In 1708 he was elected member of Parliament for Lostwithiel, a seat he exchanged in 1710 for Malmesbury, which place he continued to represent till his death. In 1709 he became secretary to Lord Wharton as lord-lieutenant of Ireland.

It may here be noticed that Addison's temperament, which greatly facilitated his elevation, determined its limit in a political direction. Extremely shy and even awkward in company, especially among persons of any superiority of pretension, he joined with this diffidence extreme caution of offending and solicitous anxiety to oblige. These qualities, which recommended him to men in office, wholly disqualified him for parliamentary life. He is said to have once attempted to speak in the House: but, if ever he had a higher ambition, he sank at once and irretrievably into the position of an absolutely silent member.

The fall of the ministry in August 1710, followed by the accession to power of an uncompromising Tory ministry, happened fortunately for Addison's fame. While he was absent in Ireland his old school companion Steele had started a paper partly devoted to news; but chiefly to essays of a social, moral, and literary character, the *Tatler*. Addison discovered the author

of the enterprise by a literary criticism which he had communicated to his friend, and was readily admitted to share in it. The *Tatler* was begun 12 April 1709, and terminated 2 Jan. 1711. It was followed on 1 March by the *Spectator*, which dropped the news section and consisted entirely of essays. It continued till 8 Dec. 1712. The *Guardian* succeeded, from 2 March to 1 Oct. 1713, and the *Spectator* was resumed from 18 June to 20 Dec. 1714. The *Tatler* was published thrice weekly, on Tuesdays, Thursdays, and Saturdays; the *Spectator* and *Guardian* every week day. The bulk of the papers were contributed in nearly equal proportion by Steele and Addison.

Addison's contributions to the *Spectator* are distinguished by one of the initials C., L., I., O. In humorous and satirical character sketches he hardly excelled, perhaps equalled Steele. If more refined he was less direct and pointed. But he was far ahead of his fellow contributor in scholarship and literary taste, and in the breadth and height of his ambition. He poured forth the stores of his knowledge on a greater variety of subjects, and indulged his imagination in more elaborate and artistic creations. But besides these independent efforts of his own, he aspired to be a judge and censor of the literary productions of others, and he was, perhaps, beyond any man of his day, well qualified for the task. Certainly his judgments had less force and perhaps less depth than Johnson's, but they had much more of breadth, harmony, and completeness, were woven with more art into a system depending on theoretical principles, and were delivered with a grace and eloquence of which the oracular moralist was no master. If his system was somewhat shallow, it had probably the merit of directing attention more to criticism, and preparing the way for better and more philosophic standards of appreciation. Among the most remarkable of his contributions to the *Spectator* are his criticism on Milton's ‹Paradise Lost,› his essays on the ‹Pleasures of the Imagination,› ‹Vision of Mirza,› his Saturday essays on moral and religious themes, and his ‹Reflections on the Divine Perfections.› Pre-eminent among his character sketches is Sir Roger de Coverley. Steele originated the idea of a «Spectator» Club and sketched the characters of its members. That of Sir Roger was immediately appropriated by Addison, to whom the delicate humor of its subsequent development is exclusively due. The remaining works of Addison not yet mentioned are of comparatively little interest or importance. In opposition to the *Examiner*, conducted by Swift, he wrote, in the latter part of 1710, five numbers of a *Whig Examiner*. In 1713 he published, anonymously, «The Trial and Conviction of Count Tariff,» a libel on the financial policy of the ministry. He had assisted Steele at an early period with his comedy of the ‹Tender Husband,› and the drama of ‹The Drummer or the Haunted House› was published by Sir Richard Steele after his death and attributed to him. The *Freeholder*, a political paper in support of the government, published twice weekly from 23 Dec. 1715 to 29 June 1716, was written entirely by him. He also wrote a work on the ‹Evidences of the Christian Religion,› and a ‹Discourse on Ancient and Modern Learning.› ‹Cato› was brought on the stage in April 1713, reluctantly, as is said, and though destitute of dramatic qualities and even deficient in poetry had a great run of success, which was largely owing to political causes.

In August 1716 he married the Countess Dowager of Warwick. This connection brought him little accession of fortune, as the widow forfeited her jointure by her remarriage. Her haughty demeanor, nevertheless, is said to have made his home unbearable to a man of his nicety of feeling. Whether from this cause, or from the long habit of frequenting taverns, to which he appears at first to have had rather an aversion, he acquired, according to prevalent reports, a habit of excessive wine-bibbing which shortened his days. These latter days were distinguished by a return to political life, and darkened by some painful literary quarrels. On the death of Queen Anne the lords justices who assumed the government appointed Addison their secretary. For a brief period he resumed his former office of secretary to the lord-lieutenant, and in 1715 he was named one of the lords of trade. In 1717 the leading Whigs retired from office, leaving an attenuated party called the German ministry. From this ministry, on 16 April, Addison accepted office as one of the principal secretaries of state. He was probably equally unqualified in point of business capacity and of parliamentary efficiency for this responsible post, and he was probably also sensible of his own incapacity, for it is said that in accepting it he yielded to the ambition of his wife.

He retired after 11 months with a salary of £1,500. Of his literary quarrels one of the bitterest was with Pope. The cause of it was the publication by Tickell, Addison's secretary, of a part of a rival translation of the ‹Iliad,› which Pope suspected was Addison's own, and a remark of Addison's that Tickell's translation was more faithful than Pope's. Pope in revenge wrote the savage satire contained in his lines on «Atticus,» which he published after Addison's death in his «Epistle to Dr. Arbuthnot,» and which at the time he printed and distributed among his friends. Addison does not appear to have replied publicly, but in the *Freeholder* he liberally praised Pope's ‹Iliad.› Addison had also a quarrel with Gay, and on this occasion he appears to have been in the wrong, as he sent for Gay some time before his death, apologized for having injured him, and promised amends. But the saddest, as it appears to have been the paltriest, quarrel, was with his ancient comrade Steele. The cause of it was political. Steele attacked a bill for the limitation of the peerage in the *Plebeian*. Addison replied in a pamphlet called the «Old Whig.» Steele answered that Addison was so old a Whig that he had forgotten his principles, and Addison made a contemptuous reply. Addison died of asthma and dropsy at Holland House.

Of his style as a writer so much has been said that nothing remains to say but to quote the dictum of Johnson, «Whoever wishes to attain an English style, familiar but not coarse, and elegant but not ostentatious, must give his days and nights to the volumes of Addison.» Addison had great conversational powers, and his intimates speak in the strongest terms of the enjoyment derived from his society, but it is acknowledged that he was extremely reserved before strangers. There is a story told of his

having sent for his stepson, Lord Warwick, on his deathbed, and addressed him in these terms, "See in what peace a Christian can die." It is alluded to by Tickell, Addison's executor, and is first told circumstantially by Dr. Young, but the truth of the story has been questioned. Addison was buried in Westminster Abbey. He left a daughter born in the year of his death. His works were published by Tickell in four quarto volumes in 1721. An edition, with notes by Bishop Hurd, in six vols. 8vo, was published in 1811. A more complete edition with Bishop Hurd's notes was published and edited by H. G. Bohn (in the well-known series, six vols.). A recent edition (in six vols.) is that of Prof. Greene. There have been two recent editions of the *Spectator* (both in eight vols.) edited respectively by G. A. Aitkin and G. G. Smith. Among 'Lives' may be mentioned that by Lucy Aikin (1843), which drew from Macaulay an admirable essay, and that by Prof. Courthope.

Addison's Disease, a disease associated with disturbance of the functions of the suprarenal glands and characterized by general depression of the functions, anæmia, lowered tone of the circulatory apparatus, irritability of the stomach, and pigmentation of the skin. This last symptom is the most pronounced and was fully described by Addison in 1855. The disease is more common in men and between the twentieth and fortieth years. It is rare in America.

The chief symptoms are (1) pigmentation of the skin; this is a peculiar brownish, yellow to black, almost bronze-like discoloration; (2) gastro-intestinal symptoms, nausea, vomiting, at times marked pain in the abdomen, frequent attacks of diarrhœa; (3) asthenia, the patient is always very tired, and is incapable of carrying on his regular occupation; the heart muscle also suffers very markedly, there being frequent attacks of rapid and feeble pulse with vertigo, and fainting, sometimes fatal. Headache is frequent and anæmia may be present. The disease is usually fatal, but recovery has taken place.

The treatment is symptomatic, with the prolonged use of the suprarenal gland.

Addled Parliament, The, a nickname given to James I.'s second Parliament, of 1614, because it passed no statute and finished no business. It did, however, settle a far more important question than any point of administration: namely, that the Commons were to have the power of the purse thereafter — that is, the rule of the kingdom — unless the Crown crushed them by force. In a word, it proclaimed the revolution, though not consciously. The previous Parliament had been dissolved for not granting supplies until the king had abolished the illegal imposts and regulated the Court of High Commission by statute — that is, given church as well as state into their hands. The elections for 1614 were contested with a passion unknown for generations: the court candidates were overwhelmingly defeated, and 300 of the victorious ones were new men sent up for the first time, among them John Pym, Thomas Wentworth (afterward Earl of Strafford), and John Eliot. After a two months' session they became involved in a quarrel of privilege with the Lords, and the king dissolved the House on that pretext,— really on the point of their refusal of supplies,— and imprisoned four of them.

Add-Ran Christian University, a Waco, Tex., coeducational institution; organized in 1873 under the auspices of the Church of the Disciples. Reported in 1899: Professors and instructors, 20; students, 200; volumes in the library, 5,000; grounds and buildings valued at $150,000; income, $20,000; number of graduates, 200; president, Albert Buxton, Ph.D.

Ade, George, American journalist and author: b. Kentland, Ind., 9 Feb. 1866. He made his first mark as a writer for years of "Stories of the Streets and the Town" in the Chicago *News*, with remarkable variety of motive and local-reporter's knowledge; published 'Artie,' made up from these, and in 1897 the dialect story 'Pink Marsh'; in 1901-2 two sets of 'Fables in Slang,' full of pungent wit and knowledge of the less agreeable phases of human character; and in 1903 the satirical comic opera, 'The Sultan of Sulu,' a musical comedy, 'Peggy from Paris,' a political comedy, 'The County Chairman,' a comedy of college life, 'The College Widow,' and others.

Adee, Alvey A., American diplomat: b. Astoria, N. Y., 27 Nov. 1842, son of a fleet surgeon; was secretary of legation at Madrid 1870-7, *chargé d'affaires* at different times; in 1878 became chief of the United States diplomatic bureau, 1882 third assistant secretary of state, 1886 second assistant, which he still remains. He was secretary of state *ad interim* 17-29 Sept. 1898; and acting secretary during some of the most acute Chinese troubles of 1900.

Adelaide, capital of S. Australia, 7 m. by rail S.E. of Port Adelaide, on St. Vincent Gulf. It stands on a large plain, and is walled in on the eastern and southern sides by the Mount Lofty range; the town proper is enclosed by a wide belt of garden shrubbery. The first settlement was made in 1836, and named after the queen of William IV. The Torrens divides the town into North and South Adelaide, the former being occupied chiefly with residences, and the latter forming the business portion of the town. Four substantial iron bridges span the Torrens, which has been formed by a dam into a lake one and a half miles long. The streets are broad and regularly laid out, especially in Adelaide proper, to the south of the river, where they cross each other at right angles, and are planted with trees. Among the public buildings are the new Parliament Houses, erected at a cost of about $500,000; government offices, post-office, and town-hall; South Australian Institute, with museum, library, and art galleries; and hospital. The botanical garden, with the botanical garden park, covers more than 120 acres of ground. The chief manufactures are woolen, leather, iron, and earthenware goods; but the chief importance of Adelaide depends on its being the great emporium for South Australia. Wool, wine, wheat, flour, and copper ore are the staple articles of export. Among educational institutions the most important are the Adelaide University; St. Peter's (Episcopal) College; St. Barnabas Theological College, opened in 1881, and Prince Alfred (Wesleyan) College. It is the seat of an Anglican and of a Roman Catholic bishop. Glenelg, on the sea, 5 miles away, is a favorite watering-place. Pop. with suburbs (1901) 160,691.

PORT ADELAIDE, its haven, dates from 1840. It is a principal port of call for vessels arriving

from Europe; has railway communication with Melbourne, Sydney, and Brisbane. Tramways were introduced in 1878. Pop. with Semaphore about 15,000.

Adelard, or **Æthelhard,** of BATH, English philosopher and mathematician of the 12th century. Little is known of the facts of his life, except that he traveled widely, visiting Greece, Asia Minor, and Africa. He wrote 'Perdifficilis Quæstiones Naturales' and 'De Eodem et Diverso,' a philosophical allegory in which he sought to reconcile the theories of Plato and Aristotle. He also made a Latin translation of Euclid and of several Arabian mathematical treatises. See ARITHMETIC, HISTORY OF.

Adelbert College. See WESTERN RESERVE UNIVERSITY.

Ad'elieland', an Antarctic continent discovered 20 Jan. 1840 by Du Mont d'Urville. It consists of a chain of mountains without prominent peaks, with a few shallow bays filled with icebergs, and a number of islands with rounded summits.

Adelochorda, a group standing at the base of the branch of phylum *Chordata,* and including certain animals, formerly supposed to be worms, but now placed in the same group as the vertebrates. The class *Adelochorda* is represented by *Balanoglossus,* while with it are provisionally associated two forms of doubtful position, the worm-like *Rhabdopleura* and *Cephalodiscus.* The *Adelocephala* are worm-like, but from the fact that the body is in part supported by a structure supposed to be homologous with the notochord of true vertebrates, and that the animal breathes through gill-slits, like those of the lowest vertebrates, it is supposed to be related to some extinct form which gave rise to the vertebrates. It is also itself probably an ancestral persistent form. If we throw out the doubtful forms *Rhabdopleura* and *Cephalodiscus,* leaving only *Balanoglossus,* we have the old group *Enteropneusta.* A typical example of the *Adelochorda* is *Balanoglossus* (q.v.).

Adelphi College, Brooklyn, N. Y., a coeducational, non-sectarian institution, was incorporated by the regents of the University of the State of New York, 24 June 1896. It is intended to be a school of arts, a college of liberal culture. The requirements for admission and graduation are the same as those of the leading Eastern colleges. It is the only institution in Brooklyn in which a woman may obtain the usual baccalaureate degrees. The curriculum is arranged semestrally, and eight semesters are required for graduation. The courses in pedagogy are arranged so that the studies preparatory to the profession of teaching may all be taken as a part of the work offered for the degrees of bachelor of arts and bachelor of science. From the beginning the college has always offered special facilities to students who wish to enter the profession of teaching. It also makes provision in afternoon, evening, and Saturday morning classes for teachers in public schools who desire to study for a degree without giving up their positions. Connected with the college are the Normal School for Kindergartners, with a two years' course, organized in 1893, and School of Fine Arts. The college reported in 1905: professors and instructors, 26; students, 500; volumes in the library, 9,000. Adelphi College maintains a preparatory department, known as Adelphi Academy, which has 50 instructors and 760 students. The total value of the property and endowments of the college is $600,000. The total annual income is $118,000.

Aden, Arabia: peninsula and town belonging to Great Britain, on the S.W. coast, 105 m. E. of the strait of Bab-el-Mandeb, the entrance to the Red Sea. The peninsula is a mass of volcanic rocks, 5 miles long from E. to W., and rising to 1,776 feet. It is joined to the mainland by a narrow, level, and sandy isthmus. The town is on the eastern shore of the peninsula, stands in the crater of an extinct volcano, and is surrounded by barren, cinder-like rocks. The main crater is known as the Devil's Punch-bowl. Frequently the heat is intense; but the climate is unusually healthy for the tropics.

The Romans occupied it in the 1st century A.D. Till the discovery of the Cape route to India (1498) it was the chief mart of Asiatic produce for the Western nations; but in 1838 it had sunk to be a village of 600 inhabitants. The increasing importance of the Red Sea route gave Aden great value as a station for the British to hold; and in 1839 after a few hours' contest it fell into their hands. It is of high importance both in a mercantile and naval point of view, especially as a great coaling station; it has a garrison and strong fortifications.

The population and resources of the place have rapidly increased since 1838, and the opening of the Suez Canal in 1869 gave it a great impetus. The value of its imports (1892–3) was over $20,000,000, while that of its exports (coffee, gums, spices) amounted to over $15,000,000. It is a telegraphic station on the cable between Suez and Bombay, and on the line to Zanzibar and the Cape. To provide for its growing population, a considerable territory on the mainland has been acquired and added to the peninsula, the total area (including the island of Perim) being 75 square miles; and the settlement, which is politically connected with Bombay (7 days' sailing, or 1,819 nautical miles, distant), has a population of over 41,000.

Adhesion, in physics, the force which holds together two surfaces brought in contact; distinguished from cohesion, the mutual attraction exerted by particles of the same body, and from affinity, since the particles adhering remain unchanged. It is a force exerted on each other by the molecules of the adhering bodies, and not to be confounded with mere mechanical contact due to pressure. The wetting of solid bodies is an instance.

It usually happens that when a solid and a liquid come in contact, a film of the liquid adheres to the solid too firmly to be detached, showing its adhesion to the solid to be stronger than the cohesion of its particles or the force of gravitation, as it can be removed only by forcible rubbing or evaporation. On the other hand, solutions are supposably cases where the adhesive force of solid and liquid overbalances the cohesive force of the solid, so that it loses its form and adheres particle by particle; but see SOLUTIONS, the true theory of which is keenly debated. The force of adhesion is measured by poising a metal plate on a balance, and then finding what additional

force is required to detach it from the surface of a liquid which does not wet it (otherwise it would be measuring the cohesive force of the liquid) nor act on it chemically. The phenomena of capillary attraction (q.v.) depend on adhesion. Solid bodies also adhere to solids: most smooth surfaces will adhere; the smoother the tighter; and two plates of polished glass laid together can hardly be parted without breaking them. If the solids are pressed together, it usually increases the adhesive force; but it depends but little on atmospheric pressure. Friction is a looser kind of adhesion, which prevents surfaces moving freely on each other, and may result from gravitation or mechanical appliances. Plating, gilding, etc., also depend on adhesion. Soldering, the use of mortar, cementing, gluing, etc., are familiar applications of the principle, intermediary substances being employed, whose particles have at once great cohesion among themselves and great adhesion to each of the bodies to be joined. A familiar example is the splitting a thin sheet of paper by pasting it between two sheets of cloth and pulling them apart after it has dried: the adhesion of paste to paper and cloth is so great that the paper fibres yield to it. Furthermore, air and other gases adhere to solids: a favorite children's experiment is to float a dry needle in a basin of water, it resting on a cushion of air; and when thermometers are filled with mercury it has to be boiled in them to expel the air that adheres to the glass. Every material body, and every particle of such body in however fine division, is surrounded by its own atmosphere of condensed gases, which are an efficient factor in many physical and chemical phenomena; this property in comminuted bodies is called adsorption, and in metallic substances is sometimes so avid that they grow red-hot.

Adiaba'tic Transformation. In thermodynamics (q.v.) a body is said to undergo an adiabatic transformation when its state or condition is modified in such a way that the following two conditions are fulfilled: (1) There is no exchange of heat between the body and its surroundings; (2) the transformation is reversible at every stage. It is usual to define the adiabatic transformation by stating the first of these conditions only; but the second is equally essential, because if it is omitted the definition will also include the transformation known as "free expansion." (See GASES, GENERAL PROPERTIES OF.) When the body under consideration is a «perfect gas,» and all possible states are excluded from consideration except such as are uniquely determined when the pressure and volume of the body are given, the adiabatic transformation requires that the product pv^k shall remain constant throughout the transformation, k being the ratio that the specific heat of the gas at constant pressure bears to its specific heat at constant volume. For air, k is about 1.41. When the changes that the body can undergo are represented graphically, as for example on a diagram in which the volume is taken as abscissa and the pressure as ordinate, the lines along which the foregoing algebraic expression is constant are called adiabatic lines or curves. Adiabatic transformations are often called isentropic transformations, from the fact that the entropy (q.v.) of the body remains constant along every such line. (For further information concerning lines used in thermodynamics, see LINE.)

Adiaphorists, ä-di-af'or-ists, or **Adiaphorites,** a party or wing of the Lutheran reformers of Germany, who held that certain things practised by the Roman Catholic Church were indifferent and might be received. In 1548 an ecclesiastical controversy broke out among the reformers. The Emperor Charles V. having issued a paper popularly called the «Interim,» in which he prescribed what faith and practice the Protestants were to adopt till the Council of Trent should dictate a permanent form of belief and worship, Maurice, Elector of Saxony, urged Melanchthon and his friends to decide what portions of the document they would accept and follow. Melanchthon considered that to a very large extent the «Interim» might be accepted and obeyed. A controversy in consequence arose between the followers of Luther and those of Melanchthon. It was called the adiaphoristic controversy, and embraced two questions: (1) What things were indifferent; and (2) whether, with regard to things indifferent, the emperor could or could not in conscience be obeyed.

Adi-Buddha, ȧ-de-bud-hȧ, from the Sanskrit, the Primord Buddha, a conception of Buddha due probably to the influence of Christianity. It came into vogue among the Northern Buddhists about the middle of the 10th century. In this conception he is represented as self-existent and omniscient.

Adige, ä'dē-je, a considerable river of N. Italy, which has its source in the Alps of Tyrol, above Brixen; it enters Italy by Bolzano and the valley of Trento, flows in a southern direction by Roveredo, parallel to and for the most part about 6 miles from the lake of Garda, then, turning abruptly toward the east, passes through Verona and Legnano; it afterward enters the great delta between the Brenta and the Po, and, forming several branches, empties its waters into the Adriatic Sea. It is a deep and rapid stream, dividing by its course the old Venetian territories from Lombardy proper. The valley of the Adige has been rendered forever memorable by the wars of Bonaparte.

Adi-Granth, the Bible of the Sikhs (q.v.), mainly compiled by the *guru* (spiritual guide) Arjun (1584–1606), fifth successor of the founder Nanak (q.v.). He gathered up the poetical pieces of his four predecessors, and fragments from other great teachers like Ramananda, Kabir, Namdev, etc., and added compositions of his own. The tenth and last Sikh guru, Govind (1675–1708), made additions to it, and composed an entirely new Granth, the «Granth of the Tenth Reign.» The language of these is an archaic Punjabi called Gurmukhi («from the guru's mouth»). These Granths, with the biographies of gurus and saints, and instructions for ritual and discipline, comprise the Sikh sacred books.

Ad'inole, a variety of the mineral albite.

Ad'ipate, any salt of adipic acid (q.v). Thus the compound of adipic acid with sodium is called sodium adipate.

Adip'ic Acid, an organic acid having the formula $C_6H_{10}O_4$, and crystallizing in monoclinic liminæ which are sparingly soluble in cold

water, but freely so in alcohol and ether. It melts at 300° F. and is formed by the action of nitric acid on natural fats.

Ad'ipite, a gelatinous mineral substance of the same composition as chabazite (q.v.).

Adipocere, ad'i-pō-sēr' Lat. *adeps*, fat, + *cera*, wax), a fatty substance consisting largely of palmitic, stearic, and margaric acids, combined to some extent with ammonia. It is sometimes formed by the decomposition of animal matter from which air has been excluded. It was first observed by Fourcroy. The most notable example of its occurrence was in the Cimetière des Innocens at Paris. A large number of coffins had been piled together in this cemetery for many years, and in 1786–87, when the coffins were removed, it was found that in many cases the corpses had been changed into shapeless masses of a dingy white color and waxy consistency, only the bones remaining unaltered. Adipocere is not a result of the decomposition of albuminous tissue, but is formed from the fats that are present in the body at the time of death, the fatty matter collecting together, undergoing further decomposition, and finally losing its glycerine and oleic acid. A similar substance, called bog-butter, is occasionally found in peat bogs in Ireland and Wales. Sometimes spelled *adipocire*.

Adipo'cerite, a mineral better known as hatchettite (q.v.).

Adipose Tissue, a fatty membrane or tissue. See FAT TISSUE.

Adiposis Dolorosa, a disease described by Dr. F. X. Dercum of Philadelphia in 1892, and characterized by enormous collections of fat in different parts of the body, not in the hands or feet, and associated with neuralgic-like pains and prickling sensations.

Its cause is unknown. The internal use of the thyroid gland has been of benefit in some cases.

Adirondack Mountains, a group in the N.E. part of New York State, lying between the depressions occupied by Lake Champlain on the E., the St. Lawrence on the N.W., and the Mohawk River on the S. The group is sometimes included in the Appalachian system, but physically and geologically the two uplifts are quite independent. The Adirondacks cover an area of more than 12,000 square miles and include within their limits most of the counties of Clinton, Franklin, Essex, and Hamilton, and portions of St. Lawrence, Lewis, Herkimer, and Warren. They are formed by several folds arranged parallel or *en echelon*, with a northeast-southwest trend, sloping on either side toward the narrow longitudinal valleys that separate the individual ridges. Most of the peaks have a rounded outline due to long-continued erosion, although in the northern part, where the highest elevations are found, the peaks are bold and picturesque and have bare rock walls rising several hundred feet in vertical escarpments. The summit of the group is Mt. Marcy, 5,344 feet above the sea, and there are many prominences exceeding 4,500 feet, including Mt. McIntyre, 5,112; Skylight, 4,920; Whiteface, 4,872; Santanoni, 4,644; and Nipple Top, 4,684 feet. Toward the south and west the elevations become less pronounced and rise but a few hundred feet above the level of the plateau, which stands 1,500 feet or more above the sea. The parallel ranges are interrupted frequently by gaps or passes; some of them, like the Avalanche Pass and Indian Pass, possessing beautiful scenic features. Gorges and waterfalls occur along many of the stream valleys, the Ausable Chasm being especially noteworthy.

Rivers and Lakes.— The Adirondacks form the water parting between the Hudson and St. Lawrence, both of which streams receive many important tributaries from this region. Most of the western region drains directly into the St. Lawrence through the Oswegatchie, Grass, Raquette, and St. Regis rivers, but a small portion is drained by the Black River, which flows into Lake Ontario. On the eastern side there are the Saranac and Ausable rivers and many short streams flowing into Lake Champlain. The Hudson River receives the waters of the Sacondaga, Indian, and Boreas, and has its source in the interior of the mountains in the northeastern part of Hamilton county.

The lakes are perhaps the most attractive feature of the Adirondacks; they are distributed over the entire area to the number of many hundreds. The greater proportion lie in the larger valleys, to which they conform more or less closely in outline, being elongated along a northeast-southwest axis. Many, however, are nestled on the higher slopes at an elevation of 2,500 feet or more above the sea. Lake Tear of the Clouds on the crest of Mt. Marcy has an altitude of 4,320 feet. Lakes Champlain and George, the largest of the Adirondack lakes, are among the most attractive sheets of water in the United States. Among the smaller lakes much frequented by tourists are Long, Raquette, and Blue Mountain in Hamilton County, the Fulton Chain in Hamilton and Herkimer counties, St. Regis and the Saranacs in Franklin County, and Lake Placid in Essex County. Most of the lakes are of glacial formation, the outlets of the old rivers having been obstructed by deposits of glacial material.

Geology and Mineral Resources.—The strata of which the mountains are formed belong to the most ancient geological period, consisting for the most part of crystalline formations which were uplifted long before the Appalachian ranges had been defined. Gneisses, granites, and basic igneous rocks predominate, although there are small areas underlaid by limestones and quartzites. One of the most prominent types is a basic feldspar rock called anorthosite, composed almost entirely of the mineral labradorite. It constitutes the highest peaks in Essex County. On the borders these ancient formations are overlaid by early Palæozoic strata of Cambrian and Silurian age, which have been little disturbed from their original horizontal position. The whole region was invaded by the great northern ice-sheet, which eroded and polished the rock surfaces and upon its retreat left a heavy mantle of drift covering all but the highest elevations. Valuable ores and minerals occur at numerous localities. The deposits of iron ores have been of great economic importance, although in recent years the industry has suffered from competition with the Lake Superior and Pennsylvania ores, which can be extracted at much less expense. The mines of

magnetite ore near Port Henry yield a large annual output, which is shipped to distant points for smelting. There are also deposits at Lyon Mountain, Lake Sanford, and Benson Mines, and other localities, which are not exploited at present. One of the richest graphite mines in the United States is located at Hague on Lake George. Garnet for abrasive purposes is mined in large quantities at North River, while extensive deposits of foliated talc occur near Gouverneur. Marble, granite, and other stones suitable for building and other purposes, are the basis of a large quarry industry.

Forests.— Pine, spruce, and hard woods are found over extensive areas. The mountains have been denuded of much of the larger timber, and the principal lumbering industry is based upon the cutting of pulp-wood for paper manufacture. Spruce and poplar are most valuable for this purpose. The wholesale destruction of the forests has induced the State government to purchase extensive tracts with a view to forest-cultivation and to preserve the sources of the principal rivers. (See ADIRONDACK PARK.)

Game.— The Adirondacks are one of the favorite hunting-grounds of America. Owing to the stringent legal restrictions limiting the season for killing game, there is an abundance of deer, rabbits, partridge (grouse), and waterfowl. Deer are hunted chiefly by stalking, the use of dogs being prohibited. Black bear and wildcats may be found in many parts of the mountains, but moose and caribou, which formerly were plentiful, have entirely disappeared. Several moose were introduced from other States in 1902 with the hope that they might again roam through the woods in numbers. Brook and lake trout and black bass are found in most of the streams and lakes and furnish excellent sport for the angler.

Resorts.— The climate of the mountains is bracing and healthful; in the summer season the heat is tempered by cool mountain breezes and by the elevation, and the severe cold of winter is made more endurable by the dry atmosphere. There are many sanitariums for invalids, especially for those afflicted with pulmonary diseases. The pleasure-seekers, who visit the mountains in great numbers, find ample accommodations in the many hotels and camps. The railway lines afford easy access to most parts of the Adirondacks, while by taking advantage of the network of rivers and lakes the most remote regions can be reached without much difficulty. During the summer months steamboats make regular trips for the convenience of travelers on many of the larger lakes. See NEW YORK (STATE).

Adirondack Park, a large district, principally forest land, set apart by the State of New York in 1892 for the protection of the watershed of the Hudson and other rivers of the State, for public recreation, and for the practical study of forestry. (See CORNELL UNIVERSITY.) It covers Hamilton County, and parts of Essex, Franklin, Herkimer, and St. Lawrence counties, and contains many mountains and lakes. From time to time additions are made to the reservations, as the appropriations are available, and it is hoped that in time the whole region not under cultivation for crops, will be under State control, and while saved for the use of the people, will become a source of revenue to the State from the forestry industries.

Adit («approach»), an underground passage with but one opening; distinguished from the tunnel proper, which has two. In military use, the burrow by which miners approach a place they wish to sap. In industrial mining, a gently sloping drift, used to drain a mine of the water coming into the workings from the top or sides, or pumped up from below; usually but improperly called a tunnel. When there are two adits at different levels, the lower one is termed the «deep adit.» The greatest in the United States is the Sutro Tunnel, 2,000 feet deep and 20,000 feet long, made in the palmy days of the Comstock Lode near Virginia City, Nev., to drain the mines along it.

Aditi, ad'ē-tī, in the mythology of the Hindu Rig-Vedas, Infinity endued with life and form, from which are born the Adityas — the source and substratum of the universe; in later Vedic literature, the mother of the gods of storms (which are represented as life-producing), and of the sun. Aditi is the daughter of Daksha and wife of Kasyapa, and besides being the mother of the 33 gods and of the sun, was also the mother of the Tushitas, or the 12 Adityas. The latter in the Vedic literature numbered seven and are the gods of the heavenly light, with Varuna at their head. In the Brahmanas and later they numbered 12, with supposed reference to the months of the year.

Adive, a local Asiatic name of the corsac (q.v.).

Adjective. See GRAMMAR.

Adjustment, in insurance, is the determining the amount of a loss. No specific form is necessary to an adjustment. It must be intended and understood by the parties to a policy to be absolute and final, in order to render it binding. It may be made by indorsement on the policy, by payment of the loss, or by the acceptance of an abandonment. (4 Burr. 1966; 1 Camp. 134; 22 Pick. (Mass.) 191.) If an adjustment is brought about by the fraudulent conduct of one of the parties, it will not bind the other person. (2 Johns. Cas. 233; 3 Camp. 319.) If one party is led into a material mistake of fact by fault of the other, the adjustment will not bind him. (2 Johns. (N. Y.) 157; 2 Johns. Cas. 233.)

Adjutant («assistant»), in the armies of most civilized powers, a staff officer, the chief assistant to the commander of a regiment, battalion, or squadron, in the drill and discipline of the troops, and their general management off the battlefield, and in such other duties as fall to the commander's charge. In the United States army he is appointed by the colonel for four years, has the rank of captain, and is not eligible to reappointment; he is the colonel's secretary, and is generally so indispensable that in time of war ambitious men often dreaded the appointment, as death to further promotion. The squadron and battalion adjutants rank as lieutenants, are similarly appointed for two years, and have the same relation to their chiefs; there are also post, garrison, and brigade adjutants. For further details see the ‹U. S. Army Register.›

Adjutant, a large stork (*Leptoptilus argala*) found in India and southeastern Asia, and so called by the English on account of its erect, officer-like appearance. Its Hindu name is «argala.» Its height is about 5 feet, its spread of wings about 14 feet. The back and wings are slate-colored, the bare, flesh-colored head and neck are marked with black, and elsewhere it is white. The beautiful «maribou» feathers of commerce are taken from the under side of the wings. A pouch, which probably serves some purpose in connection with the organs of breathing, hangs from the under part of the neck and is capable of great distension. The bill is of great size, and the appetite of the bird is correspondingly large. It is a scavenger, its food being carrion, offal, and small live animals, and it runs freely about Indian villages, protected for its useful works. The marabou (q.v.) of Africa is a closely related species.

Adjutant-General, an officer on the staff of the commander-in-chief, his secretary and principal assistant in issuing orders and supervising their execution, making reports and keeping registers, etc.; and having general charge of the drill and discipline of an army. In the United States he ranks as major-general and is a leading officer in the War Department; he has charge of the recruiting service, collection of military information, and preparing annual militia returns. Most of the States have an adjutant-general, similarly related to their militia.

Adler, Cyrus, äd'ler, librarian and archæologist: b. Van Buren, Ark., 13 Sept. 1863. He was graduated at the University of Pennsylvania in 1883, and took the degree of Ph.D. in 1887 at Johns Hopkins, where for several years he was instructor in Semitic languages. Since 1892 he has been librarian of the Smithsonian Institution; special commissioner of World's Fair to Turkey, Egypt, Tunis, Algiers, and Morocco; President of the American Jewish Historical Society, and member of numerous learned societies. He is the author of numerous articles on Oriental archæology, Assyriology, Semitic philology, comparative religion, and bibliography; and one of the editors of the ‹Jewish Encyclopædia.›

Adler, Felix, American lecturer and scholar: b. Alzey, Germany, 13 Aug. 1851, son of an eminent Jewish rabbi. In 1857 he emigrated to the United States, in which country and at Berlin and Heidelberg he was educated. After being for some time professor of Hebrew and Oriental literature at Cornell he founded in New York (1876) the Society for Ethical Culture, of which he is lecturer. Similar societies have been established elsewhere in the United States and in other countries. He is an effective writer and speaker. He has published 'Creed and Deed' (1878); 'The Moral Instruction of Children' (1892). In June 1902 he was called to the newly created professorship of social and political ethics in the department of philosophy in Columbia University.

Adler, George J., German-American philologist: b. Germany, 1821; d. 1868. He came to New York 1833; graduated at the University of the City of New York 1844, and from 1846–54 was professor of German there. He published a valuable 'German-English Dictionary' (1848, many editions since), still very useful for its careful discrimination of synonyms; ‹German Grammar› (N. Y. 1868); ‹Wilhelm von Humboldt's Linguistic Studies› (N. Y. 1868), and translated Fauriel's ‹History of Provençal Poetry.›

Adler, Hermann, Anglo-Jewish leader: b. in Hanover, 29 May 1839. He has lived most of his life in England, where he has held many positions of high trust connected with his race, having been since 1891 chief rabbi of the British Empire, and has been active in general benevolence. He was principal of the Jews' College, London, 1863–91, and as chief rabbi became its president. Besides sermons, lectures, etc., he has written ‹The Jews in England›; ‹The Chief Rabbis of England›; ‹Ibn Gabirol, the Poet Philosopher,› etc.

Adler, Nathan Marcus, German-Jewish leader: b. Hanover, 1803; d. 1890. Educated at Göttingen, Erlangen, and Würzburg, he became chief rabbi of Oldenburg 1830, of Hanover and the provinces 1831; and of the British Empire 1845. He was a chief organizer of schools for Jews in England, assisted Sir Moses Montefiore in raising the £20,000 fund for Palestine, was co-founder of the United Synagogue (association of the leading synagogues), and founder and first president of the Jews' College. He published several volumes of sermons and a commentary on the Targum.

Administration, in law, the management of the personal estate of anyone dying intestate or without an executor. If the deceased leaves real estate, the estate devolves upon heirs related by blood; if personal property is left and no executors named, administrators are appointed by some court.

In the United States a surrogate or judge of probate appoints the administrator, and grants letters of administration. The administrator is a trustee within the jurisdiction of a court of equity as well as of a court of probate. His duties are to inventory the estate, collect accounts due, pay all debts, and distribute the remainder among those entitled to it. In England the power of such appointment was vested in the ecclesiastical courts until 1857, when it was transferred to a court of probate. The personal property of a decedent is appropriated to the payment of his debts so far as required, and until exhausted must first be resorted to by creditors; but by certain statutes, courts may grant an administrator power to sell, lease, or mortgage real estate when the personal estate of the deceased is not sufficient to pay his debts. At common law the real estate of an intestate goes to his heirs; the personal to his administrator. The fundamental rule is that all just debts shall be paid before any further disposition of the property.

Ancillary Administration.— That which is subordinate to the principal administration, for collecting the assets of foreigners. It is taken out in the country where the assets are locally situate.

Of Estates.— The term is applied broadly to denote the management of an estate by an executor, and also the management of the estates of minors, lunatics, etc., in those cases where trustees have been appointed by authority of law to take charge of such estates in place of the legal owners.

Foreign Administration.— That which is exercised by virtue of authority properly conferred by a foreign power. In England and in the United States the general rule is that letters granted abroad give no authority to sue or to be sued in another jurisdiction, though they may be ground for new probate authority. Consequently, when persons are domiciled and die in one country, as A, and have personal property in another, as B, the authority must be had in B, but exercised according to the laws of A. (Story Confl. Laws, 23, 447.) There is no legal priority between administrators in different States. The principal administrator is to act in the intestate's domicile, and the ancillary is to collect claims and pay debts in the foreign jurisdiction and pay over the surplus to his principal. (2 Metc. (Mass.) 114; 3 Day, 74.) But some courts hold that the probate of a will in a foreign State, if duly authenticated, dispenses with the necessity of taking out new letters in their State. So it has been held that possession of property may be taken in a foreign State, but a suit cannot be brought without taking out letters in that State.

Public Administration.— That which the public administrator performs. This happens in many of the States by statute in those cases where persons die intestate, without leaving anyone who is entitled to apply for letters of administration.

Jurisdiction over administrations is in England lodged in the ecclesiastical courts, and these courts delegate the power of administering by letters of administration. In the United States administration is a subject charged upon courts of civil jurisdiction. A perplexing multiplicity of statutes defines the powers of such courts in the various States of the Union. The public officer authorized to delegate the trust is called surrogate, judge of probate, registrar of wills, etc. As to surrogate courts and proceedings therein in the State of New York, see the Code of Civil Procedure (Chase's ed. 1902, ch. 18). The death of the intestate must have taken place or the court will have no jurisdiction. A decree of the court is *prima facie* evidence of his death and puts the burden of disproof upon the party pleading in abatement. 26 Barb. 383. The formalities and requisites in regard to valid appointments, and rules as to notice, defective proceedings, etc., are different in the various States.

In Politics, the word is applied to the collective body of governmental officers exercising authority as an executive power; in this sense being the equivalent of the term government; as, the bill was an Administration (or government) measure. It is also applied to a political term of office; as, during the Roosevelt administration.

Admirable Crichton, crē'ton, (N. Irish Crī'ton). See CRICHTON, JAMES.

Admiral (Arabic *amīr-al* or *emir-al*, « commander of the »— whatever follows it), the highest rank of naval officer. The first English admiral was William de Leybourne (1286). His duties corresponded to those afterward vested in the lord high admiral; viz., the administrative powers now delegated to the lords commissioners of the admiralty. In Great Britain there were formerly three grades of admirals, commanding subdivisions known as the red, the white, and the blue, from the colors of their flags; but this distinction is now abolished. The last lord high admiral was the Duke of Clarence, afterward William IV. In the British navy admirals are classified as admirals, vice-admirals, and rear-admirals, ranking respectively with generals, lieutenant-generals, and major-generals. These distinctions were adopted in the United States navy during the Civil War; the rank of rear-admiral being established in 1862, vice-admiral in 1864, and admiral in 1866, all created for Farragut. David D. Porter succeeded in the titles of vice-admiral and admiral, both of which grades were abolished at his death (1891). In 1899 the title was recreated in the United States navy, and conferred upon George Dewey. In 1882 Congress reduced the number of rear-admirals from 10 to 6, and in 1899 increased it to 18, comprising two classes of 9 each: the first corresponding in rank to major-generals in the army, and the second to brigadier-generals. See NAVY OF THE UNITED STATES.

Admiral. (1) In entomology, a nymphalid butterfly,— any one of several species, as the red admiral (*Pyrameis atalanta*), and the white admirals of the genus *Basilarchia*. (2) In conchology, one of the cones (*Conus ammiralis*). See CONE-SHELL.

Admiralty Inlet, a narrow body of water connecting Puget Sound with the Strait of Juan de Fuca.

Admiralty Island, a mountainous island, 90 m. long, off the W. coast of Alaska, to the N.E. of Sitka; belongs to the United States.

Admiralty Islands, a group of 40 islands, to the N.E. of New Guinea; Basco, the largest of them, being 60 m. in length, mountainous, but fruitful. The total area of the islands is 878 square miles. They were discovered by Schouten in 1616. Carteret named them in 1767. Some are volcanic; others are coral islands. They abound in cocoanut-trees and are inhabited by a race of tawny, frizzle-headed savages of the Papuan stock, about 800 in number. Together with New Britain and some adjoining groups they were annexed by Germany in 1885, and now form part of the Bismarck Archipelago.

Admiralty Law, the system of jurisprudence administered by admiralty courts.

In American law, a tribunal exercising jurisdiction over all maritime torts, contracts, injuries, or offenses. Its civil jurisdiction extends to cases of salvage, bonds of bottomry or hypothecation of ship and cargo, seamen's wages, seizures under the laws of impost, navigation, or trade, cases of prize or ransom, charter-parties, contracts of affreightment between different States or foreign ports, contracts for conveyance of passengers, contracts with material-men, jettisons, maritime contributions, and averages, and generally to all assaults and batteries, damages, and trespasses, taking place on the high seas. Its criminal jurisdiction extends to all crimes and offenses committed on the high seas or beyond the jurisdiction of any country. A suit is commenced in admiralty by filing a libel, upon which a warrant is issued for the arrest of the person, or attachment of his property if he cannot be found, or a simple monition to appear; or, in a proceeding *in rem*, a warrant is issued for the arrest of the thing in question.

Admission. *In practice,* the act by which attorneys and counsellors become recognized as officers of the court and are allowed to practise.

In corporations or companies, the act of a corporation or company by which an individual acquires the right of a member of such corporation or company. In trading and joint-stock companies no vote of admission is requisite, for any person who owns stock therein, either by original subscription or conveyance, is in general entitled to, and cannot be refused, the rights and privileges of a member. Nothing more can be required of a person demanding a transfer on the books than that he prove to the corporation his right to the stock.

In evidence, a concession or voluntary acknowledgment made by a party of the existence of certain things or conditions, or of the truth of certain statements. The admissions or declarations of a party in respect to the subject-matter of an action at law or suit in equity, may always be given in evidence against him. As distinguished from confessions, the term is applied to civil transactions, and to matters of fact in criminal cases where there is no criminal intent. Express or direct admissions are those which are made in direct terms. Incidental admissions are those made in some other connection, or involved in the admission of some other fact. Implied admissions are those which result from some act or failure to act of the party. To be considered as evidence, admissions may be made by a party to the record or one identified in interest with him, but not where the party of record is only a nominal party and has no active interest in the action.

Adobe, ä-dō'ba (Sp., from *adobar,* to daub or plaster), colloquially «dobie»: sun-dried bricks, from any native clays; especially those made in the arid western and southwestern regions of the United States, as in the Great Basin, Arizona, New Mexico, etc., by molding the bricks and then turning the sides alternately to the sun day by day for a week or two, stacking up for use when sufficiently baked. These, however, are the resource only of people in an inferior state of civilization, as the rain soon dissolves them into streams of mud; hence also they are impossible at all save where rain is very infrequent. The sizes are usually two, 18 x 9 x 4 and 16 x 12 x 4, the larger ones in the best building used as headers (the greatest length crosswise to the wall) and the others as stretchers (lengthwise). The earliest building material in Assyria and Egypt was adobe, usually strengthened with straw, and it is still much used in Japan and China. Adobe soils are clay soils very plastic when wet, but too hard for cultivation when dry; they are lightened by plowing in sand or sandy loam, and are often very fertile.

Adolescence, the period of human development which extends from puberty to mental and physical maturity. Clouston restricts puberty to the «initial development of the function of reproduction»; while, by adolescence, he denotes «the whole period of 12 years [about 13–25] from the first appearance up to the full perfection of the reproductive energy.» The period of adolescence is characterized by important anatomical, physiological, and mental changes which attend the development and the ripening of the adult individual. The first appearance of the reproductive functions, at puberty, is followed by a long process of gradual change during which the secondary sexual characteristics are matured and during which, also, general nervous functions are profoundly modified. The progress of adolescence depends somewhat upon sex — the female maturing slightly faster than the male — and upon racial and social conditions.

The mind of the youth, especially in the latter half of adolescence, discovers new instincts, new impulses, new powers of imagination and of sensibility. Along with the dawning consciousness of sex, come strong emotions and desires and a sense of novel relations and untried responsibilities. «The adolescent feels instinctively that he has now entered a new country, the face of which he does not know, but yet that is full of possibilities of good and happiness for him.» Ideals are formed, romantic situations imagined, and adventures planned. The feelings are unstable and are apt to fluctuate between excitement and depression. The boy is likely to develop a pronounced egotism, a longing for action, and a desire to impress persons of the opposite sex. The girl displays equally characteristic traits; such as sentimentality, coyness, self-sacrifice, and a craving for admiration. It should be remarked, however, that the adolescent consciousness is subject to wide individual variations. It is during this stage that individuality comes into prominence; for it is then that those hereditary tendencies which underlie temperament and character are fully realized. As a result, the youth attains not only a general sexual maturity but a definite personality as well.

But «bad» as well as «good» inheritance comes to light during adolescence; and, since it finds the developing organism in an exceedingly unstable equilibrium, the result is not infrequently physical and mental derangement. Various mental diseases — particularly mania and hysteria, which are marked by wide emotional disturbances — frequently appear during the latter half of the adolescent years (20–25). Some alienists recognize a distinct type of «adolescent insanity.»

Consult: G. S. Hall, ‹Adolescence› (1904); Clouston, T. S., ‹The Neuroses of Development› (1891); ‹Mental Diseases› (5th ed. 1898), Lecture xvi.

Adolf of Nassau. See ADOLPHUS OF NASSAU.

Adolphus, or **Adolf, of Nassau,** Emperor of Germany: b. about 1250; d. 2 July 1298. He was elected emperor 1 May 1292, and was crowned at Aix-la-Chapelle 25 June in the same year. He owed his election in part to intrigues with the electors of Cologne and Mainz, who imposed on him the hardest conditions; but, refusing to fulfil them, he soon saw himself hated and deserted. Urged by want of money, he took £100,000 sterling from Edward I. of England to assist him against Philip the Fair of France; but obeyed the Pope's prohibition with alacrity. He thus made himself contemptible to the German princes, and became still more odious by taking advantage of the hatred of Albert, landgrave of Thuringia, against his sons, and purchasing this territory from him. This involved him in a fruitless five-years war to subjugate his purchase. Disgusted, and urged on by Albert of Austria, the majority of the

college of electors cited Adolphus before it; he failing to appear, the throne was declared vacant 23 June 1298, and Albert of Austria was elected. A war already existed between the rivals, in which Adolphus seemed superior until he was outmanœuvred and surrounded at Gallheim, and fell by Albert's own hand.

Adonai, a-dō'nAI, a Hebrew name for the Supreme Being; a plural form of Adon, «lord,» combined with the pronoun of the first person. In reading the Scriptures aloud, the Jews pronounce «Adonai» wherever the old name «Jhvh» is found in the text; and the name «Jehovah» has arisen out of the consonants of «Jhvh» with the vowel points of Adonai.

Adonijah, the fourth son of King David, by Haggith. His claim to the throne was best after Absalom's death, and the chief commander Joab and the high-priest Abiathar supported him; but the captain of the body-guard Benaiah, the priest Zadok, the prophet Nathan, and Solomon's mother Bathsheba, induced the old king David to make Solomon associate at once. Adonijah fled to the tabernacle for protection; but after the death of David he was slain by order of Solomon on the pretext that his request for a concubine of David's was a claim to the throne.

Adonis, a-dō'nis, in Greek legend, son of Myrrha, daughter of Cinyras king of Cyprus; born in Arabia. Before the birth of her son she was transformed into the tree which produces the fragrant gum called by her name; this, however, did not hinder his being brought into the world in due season. He grew up a model of manly beauty and was passionately beloved by Aphrodite (Venus), who quitted Olympus to dwell with him. Hunting was his favorite pursuit, until, having gone to the chase against the entreaties of his mistress, he was mortally wounded in the thigh by a wild boar. Venus, coming too late to his rescue, changed his blood into flowers. After death he was said to stand as high in the favor of Persephone (Proserpine) as before in that of Aphrodite; but, the latter being inconsolable, her rival generously consented that Adonis should spend half the year with his celestial, half with his infernal mistress. This is a highly decorated form: the simpler and older myth seems to have been that Aphrodite and Persephone contested the beautiful child's possession, and Zeus ordered that he should spend four months with each and four as he chose. The fable has been variously interpreted. The alternate abode of Adonis above and under the earth is typical of the burial of seed, which in due season rises above ground for the propagation of its species. How much of the myth was cause and how much result of the famous Greek woman's festival, the Adonia, cannot be said. This represented the union of Adonis and Aphrodite on one day and the sorrow over his death the other, and the women performed the funeral rites over small images of him; also planting quick-growing herbs like fennel and lettuce in shards filled with earth, and throwing them into springs after the burial. It was a worship of the reproductive principle of plants, which after a short life die and are buried and again spring up; naturally, it was involved with the grossnesses of phallic worship, for which all growth-cults tended to be an excuse. The name is Semitic, *adon,* «lord,» — though of course all the local gods were «adons» of the place,— and the cult was widespread in the East; in Phœnicia the Adon was termed Thammuz, «the hidden.» The Greek celebration was often performed by the priestesses of Aphrodite, courtesans; but Theocritus' charming Idyl XV. shows that in his time at least it was perfectly respectable for decent women to attend.

Adonis, a genus of plants of the natural order *Ranunculaceæ,* or crowfoot family. The genus is a native of Europe, and only a single species, *A. autumnalis,* the «pheasant's eye» of the flower-garden, is shown in the United States. It is a low leafy annual with scarlet or crimson flowers, darker in the centre. It is said to have been stained with the blood of Adonis.

Adoptian Controversy, The, one which arose in Spain toward the end of the 8th century. Its leaders were Felix, bishop of Urgel, and Elipand, archbishop of Toledo; they modified the doctrine of Nestorius (see NESTORIANISM) to the opinion that Christ was the Son of God only in his divine nature, and in his human nature only so by adoption. It was hoped that this doctrine would be more acceptable to the Mohammedans than the orthodox view, and a means toward their conversion; and Elipand was a zealous missionary among them. Felix introduced it into Frankish Spain, and Charlemagne called a synod at Regensburg (Ratisbon) in 792 to have him explain and justify it. Instead he renounced it, confirming the renunciation by a solemn oath to Adrian I., to whom the synod sent him; yet on returning to his diocese he taught it as before. Another synod was held at Frankfort in 794, and the doctrine was formally condemned, neither Felix nor any of his followers attending. After some controversy a commission of clergy was sent to Spain to put down the heresy. Leidrad, archbishop of Lyons, one of the commission, persuaded Felix to go before a synod at Aix-la-Chapelle in 799 and recant; which after a week's dispute with the great Alcuin he did, and was prevented from further relapse by being kept under surveillance at Lyons for the rest of his life, to 816. Elipand, at Toledo, maintained his Adoptian views despite their ban by the Church; but after his death they were abandoned by practically all. Occasional advocates afterward arose during the Middle Ages, however, and the question has been discussed even in modern times.

Adoption, the act of taking a stranger into one's family, as a son or daughter; or the taking of a person, a society, etc., into more intimate relations than formerly existed with another person or society; or the taking as one's own, with or without acknowledgment, an opinion, plan, etc., originating with another; also the selecting one from several courses open to a person's choice.

In law, both ancient and modern, the act of taking a stranger into one's family constituted the person so adopted one's heir to all intents and purposes. The practice was common among the Greeks and Romans, and is still in use among some modern nations.

A proceeding which so materially affects the succession of property and the rights of natural heirs is a very important one. It is not recognized by the common law of England, and exists only in the United States by special statute. Comparatively few of the States have engrafted it upon their systems of jurisprudence. But among many of the Continental nations it has been practised from the remotest antiquity. The effect of adoption was to cast the succession on the adopted in case the adopting father died intestate.

The statute in force in the State of Michigan is substantially similar to other statutes in the various States upon the subject. The Michigan statute provides, among other things, that the person or persons so adopting such child shall thereafter stand in the place of a parent or parents to such «child-in-law,» and be liable to all the duties, and entitled to all of the rights, of parents; and such child shall thereupon become an heir-at-law of such persons, the same as if he or she were in fact the child of such person or persons.

Adoption by matrimony is the placing the children of a former marriage on the same footing, with regard to inheritance, etc., as those of the present one.

Adoption by testament is the appointing of a person one's heir on condition of his assuming the name, arms, etc., of his benefactor.

Adoption by hair was performed by cutting off the hair of the person adopted and giving it to the adoptive father.

Adoption by arms was the presentation of arms by a prince to a brave man. These the recipient was expected to use for the protection of his benefactor.

In heraldry, arms of adoption are the heraldic arms received when the last representative of an expiring aristocratic family adopts a stranger to assume his armorial bearings and inherit his estates. The recipient may obtain permission from parliament to take the name of his benefactor, either appended to, or substituted for, his own.

In Scripture and theology, the act of admitting one into the family of God, or the state of being so admitted. The previous position of the person adopted in this manner was that of a «servant,» now he is a «son,» an «heir of God,» and a «joint heir with Christ.»

In ecclesiastical language, adoption by baptism is the act of becoming godfather or godmother to a child about to be baptized. Unlike real adoption, however, this does not constitute the child heir to its spiritual father or mother.

Adoration, in unspecialized modern usage, a spiritual homage to God; but originally an act to express obedience and reverence performed before the images of the gods. Among the Romans it was performed by raising the hand to the mouth, kissing it, and then waving it in the direction of the image; the devotee had his head covered except before Saturn and Hercules, and after the act turned himself around from left to right. Sometimes he kissed the feet or knees of the images. This homage was afterward transferred to the emperors, by bowing or kneeling, laying hold of the imperial robe, and then pressing the hand to the lips. The Oriental methods were of course still more abject,— bending the knee, falling on the face, striking the earth with the forehead, and kissing the ground or floor. Alexander borrowed this from the Persians and made it a feature of his court: the rough Macedonian Cassander burst into a roar of laughter when he saw the Persian grandees performing this *kotow* (the Chinese term for the same act) before Alexander, who was so enraged that he seized him by his long hair and dashed his head against the wall. But the Greeks considered it impious and degrading, and the best of them would not bend to it: Conon refused it to Artaxerxes, and Callisthenes to Alexander. The abject degradations which the mediæval far-Eastern rulers exacted from foreign traders, by submitting to which the Dutch purchased trade privileges, though the English would not,— crawling on the face from the door to the monarch's seat, licking up the dust as they went, till the victim was often unable to speak when he reached it, and could only gasp with his mouth full of dirt,— are well known. Milder forms in modern times, hardly thought degrading even by the sturdiest democrat, are kneeling and kissing the monarch's hand; and the similar homages of lovers have never been considered so. The ceremony of kissing the cross embroidered on the Pope's slipper is a like form, said to have been borrowed from a similar ceremony introduced by the emperor Diocletian, who greatly extended court ceremonial. The original signification of the word as an act and not an emotion is preserved in the marriage service of the English and Protestant Episcopal Churches, «with my body I thee worship.» In the Roman Catholic Church, also, a distinction is made between *latria*, the worship due to God alone, and *dulia* the veneration paid to the Saints, and *hyperdulia*, that accorded to the Virgin.

Adour, a river of southern France, having its source in the mountain ridge of the Tourmalet, in the department of Hautes-Pyrénées. Its course is first N., then W., S.W., and S.S.W., passing St. Sever and Dax, to the former of which it is navigable, and falling into the sea a little below Bayonne, flowing through many exceedingly fertile valleys. Its whole length is estimated at about 200 miles. The current is rapid, and sometimes serious inundations are caused by the melting of the snows on the slopes of the Pyrenees. At the mouth of the river there is a shifting bar.

Adowa, or **Adua**, Abyssinia, capital of Tigré; on the left bank of the Hassam, a tributary of the Tacazzé, 6,000 ft. above the sea, about 10 m. E. of Axum. It is the chief commercial depot on the great caravan route from Massowah to Gondar, about 110 m. from the former. Though it still carries on some trade and has manufactures of cotton cloths, iron, and brass ware, owing to the Abyssinian civil wars it has greatly declined from its former prosperity and presents a rather miserable appearance. The inhabitants, numbering about 4,000 in 1902, are considered the most civilized of the Abyssinians. It was here that the Italian Gen. Baratieri was defeated by the Negus Menelek, 1 March 1896, when 7,000 men, 250 officers, and the whole artillery were lost.

Adra (the ancient Abdera), a seaport of southern Spain, in the province of Almeria; 29 m. W.S.W. from the town of that name, near the mouth of the Adra, on an eminence facing the Mediterranean. The inhabitants are employed in agriculture, fishing, distilling brandy, and manufacturing lead from the ore produced from the extensive mines in the neighborhood. Pop. (1901) about 12,000.

Adragan'thin (from *adragant*, a corrupt form of *tragacanthe*), a gum, better known as bassorin (q.v.).

Adrar', Sahara, a district peopled by Berbers, possessing camels, sheep, and oxen, and cultivating dates, wheat, barley, and melons. Chief towns, Wadan, pop. 4,000, and Shingit, which has inexhaustible beds of rock-salt. The region embraces about 30,000 square miles and since 1892 is a part of the French possessions.

Adrastus, in Greek legend, king of Argos, son of Talaus and Lysimache. Polynices, being banished from Thebes by his brother Eteocles, fled to Argos, where he married Argia, daughter of Adrastus. The king assisted his son-in-law, and marched against Thebes with an army led by seven of his most famous generals. All perished in the war except Adrastus, who, with a few men saved from slaughter, fled to Athens and implored the aid of Theseus against the Thebans, who opposed the burying of the Argives fallen in battle. Theseus went to his assistance and was victorious. In a later story Adrastus after a long reign died from grief occasioned by the death of his son Ægialeus. He was worshipped at Sicyon, Megara, and Athens, perhaps also at Argos and the Troad. See Argos; Thebes.

Adrets, Baron des, Francis de Beaumont: b. Dauphiné, 1513; d. 1587; a violent French Huguenot, who distinguished himself by many daring exploits as well as cruelties. From 1562 on he made himself noted for a ferocity matching his opponents, but seemingly from no religious motive. He subsequently became a Catholic, but died as he had lived, in general detestation. At some places he obliged his prisoners to throw themselves from the battlements upon the pikes of his soldiers. Reproaching one for retreating twice from the fatal leap, « Sir,» replied the man. « I defy you, with all your bravery, to take it in three.» This keen rejoinder saved his life.

Adria, N. Italy, in the province of Rovigo, between the Po and Adige, is one of the oldest cities in Europe, having been founded by the Etruscans. So late as the 12th century A.D. it was a flourishing harbor on the Adriatic Sea, to which it gave name; but by the continual deposition of alluvium on the east coast of Italy it has been gradually separated from the sea, from which it is now 15 miles distant. It still retains several interesting remains of Etruscan and Roman antiquity, with a fine cathedral. It has a considerable trade in cattle, grain, and wine, silk, linen, leather, and pottery. Pop. (1900) 15,649.

Adrian, Emperor. See Hadrian.

Adrian I., Pope, b. Rome; succeeded Stephen III. in 772; d. 795. Like his predecessor, he had to struggle against the power of the Longobards, who had invaded the Exarchate and other provinces bestowed by Pepin, king of the Franks, on the Roman see. Adrian applied to Charlemagne for assistance against Desiderius, king of the Longobards. Charlemagne crossed the Alps, defeated Desiderius, and overthrew the Longobard kingdom in 774; he then went to Rome, where Adrian acknowledged him as king of Italy, and the latter renewed Pepin's grant. Charlemagne paid another visit to Adrian at Rome in 787, when his son Pepin was christened by the Pope. In 787 the seventh General Council of the Church was held at Nicæa. Adrian died after a pontificate of nearly 24 years. He was a man of talent and dexterity; he succeeded in gaining and preserving the friendship of the greatest sovereign of his time, and saved Rome from the last barbarian invaders of the Western Empire. He was the first Pope to change his name on election.

Adrian II., b. Rome; succeeded Nicholas I. 867; d. 872. He had been married and had a daughter by his wife Stephania, from whom he afterward separated in order to live in celibacy. During his pontificate Photius, Patriarch of Constantinople, withdrew from the Church of Rome; from which time dates the schism between the Greek and Latin Churches. He was succeeded by John VIII.

Adrian III., b. Rome; succeeded Marinus 884, and died the following year.

Adrian IV., the only Englishman ever raised to the papacy; succeeded Anastasius IV. 1154; d. 1 Sept. 1159. He was Nicholas Brakespeare, and for some time filled a mean situation in the monastery of St. Albans. Being refused the habit in that house, he went to France and became a clerk in the monastery of St. Rufus, of which he was afterward chosen abbot. Eugenius III. created him cardinal in 1146, and, in 1148 made him legate to Denmark and Norway, which he converted to Christianity. As Pope he granted to Henry II. a bull for the conquest of Ireland. In 1155 he excommunicated the king of Sicily; and about the same time the Emperor Frederick II., meeting him on a journey, held his stirrup while he mounted his horse. Adrian took the emperor with him and consecrated him king of the Romans in St. Peter's church. The next year the king of Sicily submitted and was absolved. His term was stormy: the Romans, influenced by Arnold of Brescia (whom he put to death), opposed him; his high claims for the papacy opened the long struggle with the Hohenstaufen house; and he was about to excommunicate Frederick II. when he died. He was succeeded by Alexander III.

Adrian V., a Genoese, succeeded Innocent in 1276, and died five weeks after his election. He was succeeded by John XX.

Adrian VI., succeeded Leo X. 1522; d. 1525. He was born at Utrecht, of an obscure family, advanced himself by his talents to the post of vice-chancellor of the University of Louvain. Ferdinand of Spain gave him the bishopric of Tortosa. After Ferdinand's death he was co-regent of Spain with Cardinal Ximenes. He was elected Pope chiefly through the influence of Charles V., whose authority was then spreading over Italy. He was succeeded by Clement VII.

Adrian, Mich., city and county-seat of Lenawee County. (Adrian's first name was Logan.) It was founded in 1825 by Addison J. Comstock, incorporated as a village in 1828, and as a city in 1833. Situated on the Raisin River, 30 miles from Toledo, and 59 miles from Detroit, at intersection of Lake Shore, Wabash and Detroit Southern R.R.'s. The branch lines of Lake Shore, to Jackson, to Detroit, and to Fayette, Ohio, terminate here.

Commerce and Manufactures.— Apart from its large business in agricultural products, Adrian has become an important manufacturing centre. It has extensive foundry and machine shops, and a large flouring mill. The Adrian Manufacturing Company, the American Electric Fuse Company, the Bond Steel Post Company, the Clough & Warren Company, and the Spring Brook Brewing Company are all large and flourishing concerns. Adrian saw the beginning of the woven wire fence industry, which was established here by J. Wallace Page in 1886. The Page Wire Fence Company was the pioneer in wire fence industry, and has become a great institution with its main factory here, and its wire mills at Monesson, Pa. Its output in 1904 was 17,543 miles of fence, with thousands of iron gates, employing in factories and mills 1,627 men. Another large fence company is the Lamb Wire Fence. Its output was $1,000,000 for 1904, with 150 employees, and running 25 fence looms. The Adrian, the Lion, and several other new companies are also manufacturers of wire fence. The factories of the Anthony and Globe Fence Companies are not far from Adrian. Capital used in the wire fence industry at Adrian is about $3,500,000, and the number of men employed is about 1,000.

Banks.— There are four State banks, with combined capital and surplus of $456,000, and deposits of $2,750,000.

Education and Religion.— City has fine system of public schools, with 2,700 pupils, and a public library of 20,000 volumes. Adrian College and a business college furnish higher education and business training. Adrian College is controlled by Methodist Protestants, has 300 students and six departments,— literature, theology, music, arts, manual training, and preparatory school. Saint Joseph's Academy, a school for girls, with 150 pupils, is conducted by the Sisters of the Order of Saint Dominic. The Industrial Home for Girls, a State institution for education and reformation of juvenile female offenders, is located here, with 353 inmates. There are many fine church edifices and a fine Y. M. C. A. building is under construction. Two daily and one weekly newspaper are published in Adrian.

Government, Population, etc.— The city government is by mayor and board of 12 aldermen. Adrian has system of sewerage, waterworks, and electric lights, paving, public steam heating, electric street car line, and a fine new post-office building. From its beautifully shaded streets, Adrian is called the Maple City. Pop. (1904) 10,680.

Charles R. Miller.

Adrian de Castel'lo (Adriano di Castelo, ä-drē-ä'nō dē käs-tel'ō). Italian cardinal and scholar: b. Corneto, Tuscany, c. 1460; d. 1521. He was educated at Rome; sent by Innocent VIII. to England, and to Scotland and reconciled James III. to his subjects; after that monarch's death at Sauchieburn he remained in England, and obtained a prebend and rectory from Henry VII. After Innocent's death in 1492 he returned to Rome and became prothonotary or secretary to Alexander VI. (Borgia), and finally cardinal just before Alexander's death in 1503. The story that Alexander fell a victim to his own attempt to poison Adrian in order to inherit his great fortune is scouted by recent historians. In 1502, in his absence Henry VII. made him bishop of Hereford, and in 1505 bishop of Bath and Wells. In 1517 he was involved in the plot of Cardinals Petrucci, De Sauli, and Riario to poison Leo X., confessed, and was absolved on condition of paying 25,000 ducats, though deprived of his cardinalate and English dignities. He fled from Rome, however, lived in retirement till Leo's death in 1521 (probably in Venice), and died suddenly on his way back to Rome, there being a suspicion that he was murdered by a servant. He is honorably remembered as one of the first who sought to rescue Latin from its mediæval corruptions and restore it to purity. He wrote a religious treatise 'De Vera Philosophia' (The True Philosophy, 1507, printed Cologne 1548); 'De Sermone Latino et Modo Latine Loquendi' (The Latin Speech and Mode of Speaking Latin, a scholarly work published at Rome in 1515, and repeatedly since).

A'driano'ple («Hadrian's city»), Turkey: its third city in size, next after Constantinople and Salonica; 137 m. W.N.W. of Constantinople, connected by rail; near the W. end of the great Thracian coast-plain where it rises to the Rhodope Mts.; at the confluence of the large Maritza (ancient Hebrus) which drains the centre of S. Bulgaria, the Tunja from the N., and the Arda from the W., all navigable. This position and the convergence of several trade routes have made it from very old times a place of great importance: it was an antique Thracian city, rebuilt by the emperor Hadrian, seized by the Turks under Amurath (Murad) I. in 1361, and the residence of the Sultans thence till the capture of Constantinople in 1453. Since the Russo-Turkish war of 1877–8 and the separation of Bulgaria, it has lost nearly half its population and a large part of its trade. The old wall that once surrounded it, now existent only in a few fragments, has been replaced by a circle of earthworks. It has a palace and two fine bazaars, besides schools and mosques. Pop. about 80,000, half Turks and the remainder Bulgarians, Greeks, Armenians, and Jews.

It has immense historic interest as the scene of three events of the first importance. (1) The battle of Adrianople, 9 Aug. 378, A.D., the most tremendous disaster to the Roman arms since Cannæ, and incomparably greater in permanent effects. The Goths, whose head chief was Fritigern,— a man of superior genius and honorable character,— were being crowded southward by the great movement of the Huns which culminated in Attila's occupancy of all central Europe three generations later, and asked leave to settle in the lands south of the Danube they had ravaged into semi-desolation. This was granted on condition that they came unarmed and left the children of the leading families in Roman hands as hostages; but when the Goths complied, the imperial officers, who were to supply them with food, forced them to pay famine prices for it, and sold or kept many of the girls for concubines. The enraged Goths, in return, carried

fire, sword, and plunder far down into Thrace; driven back for a time, they returned in the spring of 378, reinforced by Huns and Alans, and their vanguard came near Constantinople. The emperor Valens was an incompetent but ambitious man. Jealous of his brilliant nephew. Gratian, who had just won a great victory over the Western barbarians, and eager to fight before Gratian could join him and have the credit of a fresh victory, he made a long march on a sultry dog-day and attacked the Goths with his fatigued troops. The Alan and Sarmatian cavalry surrounded and hemmed in the Roman infantry, like Hannibal at Cannæ, till they could not use their weapons; thousands were driven into a marsh; the Roman army was practically exterminated; Valens was never again seen alive, and the Goths obtained permanent possession of the broad plains south of the Danube. (2) The Treaty of Adrianople, 1829. In the Russo-Turkish war of 1828-9, Diebitsch passed the Balkans, advanced on Constantinople, and halting at Adrianople made the demands of a conqueror, and the panic-stricken Turks acceded to everything. Russia received the N.E. coast of the Black Sea, and all rights over the Caucasus tribes, the district of Akhaltsikh, and the protectorate over Moldavia and Wallachia (now Rumania); and Turkey recognized the independence of Greece. (3) The Treaty of San Stefano (q.v.), after the capture of Osman's army defending Shipka Pass in the war of 1877-8.

Adriatic Sea, or **Gulf of Venice** (ancient Mare Adriaticum), an arm of the Mediterranean, stretching in a N.W. direction from the Straits of Otranto, between the E. coast of the Italian Peninsula, and the W. coasts of Turkey, Dalmatia, and Illyria; length, about 480 m.; average breadth, about 100 m.; area, estimated at about 60,000 sq. m.. Its depth in the north, between Istria and Venice, is only from 12 to 20 fathoms, but increases in proceeding south to 100 fathoms near its centre, and to 500 fathoms between its centre and its entrance. At the straits between Otranto and Valona its depth does not exceed 350 fathoms, but increases very rapidly toward the Ionian Sea. Its opposite shores present a striking contrast, the east being generally bold and rocky, lined with islands and furnished with good harbors, but thinly peopled and comparatively sterile; while the west are low, shallow, marshy, and ill provided with harbors, though generally populous and fertile. The Adriatic is evidently a continuation of the longitudinal valley of the Po, forming a long and narrow trough between the parallel ranges of the Apennines and the mountains of Illyria. The rivers which it receives, particularly the Po, its principal feeder, have produced, and are still producing, great geological changes in its basin by their alluvial deposits. Hence Adria, between the Po and the Adige, which gives the sea its name, though once a flourishing seaport, is now 15 miles inland. The principal trading ports on the Italian side are Brindisi, Bari, Ancona, and Venice; on the opposite side, Ragusa, Fiume, Pirano, Pola, and Trieste, particularly the last, which is the principal seaport of Austria and possesses a large trade.

Adsorption (a variation of the word "absorption.") The condensation of a gas or vapor upon the surface of a solid. The fact that solid bodies are capable of condensing upon their surfaces air films or gas films of considerable density was probably first forced upon the attention of the physicist by the difficulty of obtaining a permanently good vacuum. Thus it was found that a glass globe (for example) might be highly exhausted, and yet after a time the vacuum would be found to be materially reduced, even when it was apparently impossible that any air should have leaked in from without. It is now known that unless special pains are taken to prevent it, a film of air remains condensed against the surface of the glass, even when the vacuum through the general bulk of the globe is very high; and air molecules from this film are gradually given off until the vacuum becomes much less perfect than it was at first. To prevent this action it is customary to heat the vessel that is being exhausted, as the gas film is largely driven off from the walls of the vessel when they are heated. See VACUUM.

The condensation of gaseous films upon the surfaces of solids is undoubtedly due to the molecular attraction exerted by the solid upon the gas. This molecular attraction is insensible at distances that are easily measurable, but it may be very great at points sufficiently near to the surface of the solid. The expression "sensible molecular attraction," which is in use among physicists, is indefinite, and no very precise statement can be made with regard to the limiting distance beyond which the attraction is not sensible; but from the investigations of Quincke, Plateau, Maxwell, Kelvin, and others, we may infer, in a general way, that molecular attraction is not sensible at a greater distance than about 1-200,000th of an inch. Hence it is safe to say that this is the maximum thickness that the gas film condensed on a solid surface can have.

Concerning the condition of the gas in the film we can only say that where it is in immediate contact with the solid it probably has a very great density, this density rapidly falling off as we pass away from the solid. Under ordinary conditions of temperature the air film condensed against a solid cannot actually be in the liquid state, because it is not possible for air to exist in this state at any temperature higher than 220° below zero F. (See CRITICAL POINT.)

It is well known that a solid body appears to weigh less when it has been recently heated, or is still hot, than it does when it has been allowed to stand for some time in contact with the air at ordinary temperatures. This phenomenon is apparently due, to a considerable extent, to variations in the thickness of the film of air and moisture that the body condenses upon its surface. In accurate thermometry (see THERMOMETER), where the gas thermometer, is used as a standard, great pains are taken, in filling the thermometer bulb with gas, to avoid the contamination of the thermometric gas by moisture condensed upon the surface of the bulb; the bulb being repeatedly exhausted, heated, and refilled, until there is no longer the smallest chance of any appreciable part of the original surface film remaining. The phenomena of adsorption have not yet been fully studied.

Adullam, Palestine, a town in the Shephelah, or southwestern Judean coast-land; the centre of a Canaanitish clan later fused with Judahite Hebrews, but not till after David's time, when it was still "outside Judah," for which reason he and his 400 freebooters took refuge in

its « stronghold » (not « cave,» a misreading which has led to many fruitless identifications of site and a familiar English nickname — see below) when outlawed by Saul (1 Sam. xxii.). He also dwelt there when at war with the Philistines. Rehoboam fortified it. In Judas Maccabæus' time it was in « Idumæa,» as he stopped there when he raided that territory.

Adullamites, in English history, the Liberals who left their party in 1866 and joined the Conservatives, to oppose extension of the franchise by Mr. Gladstone and Earl Russell. John Bright in a speech compared them to the outlaws in the Cave of Adullam; to which Lord Elcho retorted that the band was hourly increasing, and would deliver the Parliament from the tyranny of Saul (Gladstone) and his armor-bearer (Bright). The group was also known as « The Cave.»

Adult Education. The provision for education of adults that is widely extending at the beginning of the 20th century is the logical consequence of the belief that universal education is a necessity in a democracy, and that it is essentially an organic part of the true political and social structure. The 19th century witnessed the spread of educational opportunities open to all. These opportunities are evidenced by the increase of the length of the school term; the lengthening of the period of school life of children; the establishment of compulsory education; the increase in number of public high schools, and the establishment of colleges and universities, maintained either by municipalities or States. These facts indicate that in a true democracy no limit is recognized in the field of education, and that educational opportunity should be open to all, regardless of age or sex. Philosophically speaking, the provision for education of adults can be justified on the ground that the mind reaches its maturity long after the school days end, and that much of the best and most effective work has been done by those who have passed beyond middle age. Provision for adult education, therefore, may be considered as having two distinct lines of development: First, to provide means for overcoming illiteracy, due to immigration or to insufficient education during the proper age; and second, a provision for a continuance of education as a means of culture, on the theory that education is life.

The first form of provision for adult education established by municipalities has been by evening schools, and such schools are found in the United States and the leading countries of western Europe. These schools are either elementary schools, in which the rudiments of an ordinary education are imparted, or high schools, in which systematic instruction is given in specialties. The term of these schools, taking New York city as an example, is from 90 to 120 nights, the session being two hours a night. There were, during the year 1902–3, in New York, 11 evening high schools, and 68 elementary schools, with an average attendance of about 25,000. The total enrollment of pupils in all the evening schools of the United States, from the latest report of the commissioner of education, was 190,000. A new law has just gone into effect in New York which compels boys between 14 and 16 years of age, who have not completed the regular day school course, but who are engaged in any useful employment or service, to attend the public evening schools for not less than six hours per week for a period not less than 16 weeks in each school year or calendar year. One of the most valuable features of evening school work, especially in great cities, is teaching the foreigners who come to these cities our language and our customs, and informing them of the nature of our government. More than 10,000 foreigners attended the evening schools of New York during the winter of 1902 for the purpose of studying the English language.

Courses of instruction are also provided for the supplementing of the education of workingmen. Types of these schools are the Mechanics' Institute in England, after the model established by Dr. Birkbeck; the continuation schools that are established in Prussia and other German cities, and in the United States by such institutions as the Cooper Union (q.v.) classes for science and art; the evening classes at the Pratt Institute (q.v.); the New York Trade Schools (q.v.), and the Hebrew Technical Institute. Instruction in these institutions is given on special lines and for the purpose of increasing the skill and general intelligence of the mechanic. In Germany this instruction is given either in the evening hours of week-days or on Sundays.

Education for adults for the larger purpose of adding to the general culture of the mass of the people has taken other forms during the past 20 years. In the United States the chief agents in adult education have been the Lowell Institute (q.v.); the Chautauquan Movement (q.v.); the University Extension Movement (q.v.); the Public Lecture Movement; and the work of such institutions as the Brooklyn Institute of Arts and Sciences; The People's Institute of New York; the League for Political Education; and the People's University Extension Society. The Lowell Institute was established in Boston in 1839, through the generosity of Mr. John Lowell, a merchant of Boston, who bequeathed half of his property to the support of public lectures for the benefit of his fellow citizens. The Lowell Institute has been the means of presenting the leading lecturers of the world to the citizens of Boston, and has provided courses, not alone for the general public, but lectures for more advanced students, including instruction in science to the school teachers of Boston, and has furnished instruction by lectures to workingmen in co-operation with the Wells Memorial Working Men's Institute.

The Chautauqua Literary and Scientific Circle was established in 1878, and had for its purpose the organization of adult education. In one of its earliest announcements it says: «It is for high school and college graduates; for people who never entered either high school or college. Several of the members are over 80 years of age, very few are under 18.» The features of the Chautauqua system of education are the general survey or college outlook; the four-years cycle and the unity of each year; that is, all readers in a given year read the same course. The course of studies includes history, natural science, and art. The seat of the Chautauqua Movement is Chautauqua, N. Y., where a great summer educational city annually assembles, and where religion and education go hand in hand. The number of local reading circles in the past

25 years has been about 10,000, and there are about 300 educational gatherings that are known as Chautauquas.

The movement known as University Extension is a general provision for the education of adults. Originating in England, the attention of the University Convocation in Albany, N. Y., July 1888, was called to the matter, and on 1 May 1891 a bill was signed by the governor, appropriating $10,000 for the New York State organization of University Extension. This grant is the first case on record of a State appropriation for University Extension. Under this appropriation courses of lectures controlled by university authority were arranged, and Library Extension by means of well-selected classified libraries, suiting local needs. The University Extension work now forms a part of the Home Education department of the University of the State of New York. According to the latest report, 394 courses of three or more lectures were given during the year 1900. The American Society for the Extension of University Teaching, which has its chief office at Philadelphia, has been in operation since 1890. In the 10 years from 1890 to 1900 over 5,000 lectures were given, with a total attendance of more than 1,000,000. The University of Chicago, immediately after its opening, took part in the University Extension movement, and now the extension division of the University of Chicago forms an important department of its work. All the non-resident work connected with the University of Chicago is conducted through the extension division by means of lecture study courses, correspondence courses, study clubs, and evening and Saturday classes, and in the year 1900 it gave 17 courses of lectures in 13 different public school buildings.

The Free Lecture Movement of New York, which is being followed in other cities, is the pioneer in an adaptation of University Extension in its best sense, to the purpose of educating all the people in a great city. The provision for the free lectures was made by an act of the legislature in New York in 1889, authorizing the board of education of New York to provide for lectures to working men and working women, and an appropriation of $15,000 was made for the first year. Lectures were at first given in six schoolhouses, and the attendance during the first winter was a little over 20,000. In the year 1902–3 lectures were given in 128 different places, including not alone the assembly halls of schools, but halls of museums and in many cases church halls, with an attendance of 1,207,000. The sum expended during the year 1902 was about $125,000, and New York therefore spends a greater sum than any other city for the education of adults.

This recognition by the board of education of a great city of adult education as an integral part of its educational system, and its support from the general school fund, marks a great educational advance. The lectures are divided into two classes. First, those intended to give general culture, under which are included lectures on travel and on music (abundantly illustrated either by stereopticon or vocal and instrumental music), and other lectures on history, science, art and literature, which are given in courses of from six to eighteen accompanied by a quiz, examination, syllabus and collateral reading. The lecturers include professors from the leading colleges and universities and other men who have become distinguished in their respective callings. Co-operation with the public library is established by means of lists of books posted in the various libraries which bear upon the lectures. A further extension of this work in New York has recently been made by the giving of lectures in Italian and other foreign languages to those ignorant of English, upon subjects relating to American life and institutions. As the population of our land is becoming more and more urban, the question of proper provision for adult education will gradually become more prominent in municipal administration, and the provision for such purpose can be defended on the ground of its necessity in a democracy and also as a means of furnishing rational joy to the people. The example of New York has been followed by many of the adjoining cities and also by Boston and Milwaukee. Some agencies of adult education in New York are:

(*a*) The People's Institute, which has its seat in Cooper Union and provides lectures of an economic, social, and ethical character and arranges for discussions on these subjects.

(*b*) The People's University Extension Society, which has been in existence since 1897 and works in co-operation with settlements, missions, mothers' clubs, and other institutions, and arranges lectures on hygiene and sanitation, the care of children, civics, and American history.

The Brooklyn Institute of Arts and Sciences received its charter in 1843, but began its greatest period of activity in 1887. This institute provides for courses of lectures in science and art, and maintains a library and art and science museum, and is supported by membership dues, and in the year 1901–2 the attendance at the lectures was 254,361. The city of New York in 1901 appropriated $300,000 toward the museum of this institution.

In the cause of adult education a very important factor now is the Young Men's Christian Association. Throughout the United States, courses of study for men are established in connection with all the main associations. Provision for instruction in mechanical subjects, literature, civil government, citizenship, form a feature of such courses of study. The league for Political Education in New York has for its special object the study of political and social science, and work for municipal and national progress, and maintains day lectures and classes for men and women, and evening lectures and classes primarily for men. The summer schools that have come into existence as a result of the Chautauqua movement form a valuable feature of adult education. Prominent among these schools in America is the Catholic Summer School which meets at Plattsburg, on Lake Champlain. The objects of the school are to increase the facilities for busy people, as well as for those of leisure, to pursue lines of study in various departments of knowledge, and opportunities for instruction are provided by lectures from eminent specialists. The Columbian Catholic Summer School assembles at Madison, Wis., and the summer assembly of the Jewish Chautauqua at Atlantic City. The University of Chicago recently adopted the summer school idea, and now academic work goes on during the entire year; and Harvard University and Columbia University both now maintain summer schools.

The recognition of the right of the adult to education will have its influence on the character of schoolhouses that hereafter are to be built, and already many of the newer school buildings in New York are equipped with auditoriums with ample provision for adults. Laboratories, too, will be provided in which further education in science may be given, so that technical instruction, such a great need in an industrial age, may be encouraged. The extension of the schoolhouse will make it, as Horace Mann said, not only a nursery for children but a place of intelligent resort for men. The public schoolhouse when used for the broad purpose of the instruction of youth and the education of the adult fulfills its real mission. See EDUCATION.

HENRY M. LEIPZIGER,
Supervisor of Lectures, New York Board of Education.

Adulteration («making otherwise»), deceiving buyers of goods as to their quality by secretly adding or taking away constituents. The element of deception must be present: openly selling any mixture, however poor, is not adulteration legally or morally. In usage the term is restricted to food products, drugs, and dyestuffs; the adulteration of coinage is termed «counterfeiting» (q.v.) that of unsound meat, fish, etc., «doctoring,» a term which, with «sophistication,» is also used for wines and liquors. Adulterated woolen fabrics are colloquially but not always properly known as «shoddy.» The object is to gain more profit: with costly wares, either by diluting them with cheaper ones, or by removing some valuable element for separate sale; with cheap ones, to make them look like or have the flavor of costlier ones; with spoiled or damaged ones, to make them appear sound. Most adulterations are not directly injurious to health, the public being cheated rather than poisoned, and it is to some extent a co-operator in the deception, as the cost of wholly pure articles would greatly curtail buying; on the other hand, it is often forced into such co-operation by inability to find or know the good when willing to pay for it, and wastes its money by paying for a pure article and receiving an adulterated one. And as the reduction of the nutritive value of food is itself a great evil; as the extent or harmfulness of adulterations cannot be known offhand, and tends always to grow worse as the maker grows greedier and his character deteriorates from losing his self-respect (itself a great social evil); as honest dealers are not only prejudiced by unfair competition, and suspected of fraud when qualities are poor, but often driven into the same course in self-defense; and as hasty additions of cheap materials are always liable to come from diseased sources and menace public safety,— modern legislation constantly broadens its scope in dealing with this offense alike from a pecuniary, a sanitary, and a moral standpoint. Ignorance is no excuse to a dealer who sells adulterated wares under the ordinary trade title: it is a fraud at common law, and he may be compelled to take back the goods or pay damages.

The history of adulteration would probably be coexistent with that of trade. We know that it was practised by the Greeks and Romans, and the comic dramatists have diverting references to the «doctoring» of stale fish. English statutes exist from 1266 with penalties for debasing beer or wine and selling inferior bread or meat, while tea (see below) had later a special statute; and the law-makers have never ceased struggling with the problem. But the first great general agitation was in 1851, when the London *Lancet* produced a great effect by a special investigation and publishing analyses and names of dealers, and the first parliamentary commission was appointed. The first general adulteration act was passed in 1860.

The chief articles subject to adulteration have been, first of course the great staples of life, flour and bread, milk, butter, and cheese, with beer, wines, liquors, and tobacco, staple in use if not need; relishes and seasonings, as sugar, honey, preserves, vinegar, pickles, condiments, and spices; oil and lard; tea, coffee, cocoa, and chocolate; confectionery; drugs and dyestuffs. The selection and extent of adulterations vary indefinitely with place and time: as cost or popular wealth differs in different countries and epochs, adulterations common in one place or generation are almost unknown in another.

Beer.— The objects of its adulteration are three: to give artificial strength to weak beer, to disguise the badness of poor or spoiled beer, and to keep it from spoiling. The mineral adulterants used have been among the worst possible, as arsenic (the cause of some known deaths and very likely others) and sulphate of copper. Picric and salicylic acids are used for disguise: the latter is prohibited in Germany and is certainly liable to injure the digestive system. Alum, potash, cream of tartar, and salt, used to make beer keep, are not regarded as deleterious adulterants proper. Wild cherries, flaxseed, various herbs and foliages, etc., are employed,— cheats but not injurious.

Butter.— A formidable list may be made of the butter adulterants at different times and places,— chalk, gypsum, alum, and borax, boracic and salicylic acids, glucose, flour, etc.; but for practical purposes they may be reduced to water, buttermilk, cheese, salt, and oleomargarine (q.v.) as increasers of bulk, with arnotto, aniline yellow, etc., to improve the color. The latter is hardly adulteration either in bad intent or bad effect: the public universally connects a yellow tint with richness in cream,— quite irrationally, as the milk of many cows gives butter as white as tallow, yet of perfect quality and taste,— and the harmless pigments merely remove incorrect prejudices. The first four others are equally innocuous (save that buttermilk makes it grow rancid more quickly: it is usually carelessness or incompetence rather than fraud), and are mere diluents. In normal butter, water should not exceed 12 per cent and salt 5 per cent. Oleomargarine is not even an inferior product in any respect: its nutritive value equals that of butter, and it keeps better; and the severity of the laws regulating its manufacture and inspection guarantee its quality beyond that of any other manufactured article. Only a small percentage is directly bought for table use, the vast majority being sold to dairymen to churn with their cream into ostensible butter. Its use as an adulterant concerns business interests, not public health.

Cheese.— American and English cheeses are practically not adulterated. Fancy foreign cheeses, as the Swiss, etc., often contain coloring matter and potato meal.

Cocoa and Chocolate.— The chief adulterants are starch and sugar; but they have also contained wheat and potato flour, sawdust, oils and fats, and other things. The tests are for theobromine (the characteristic principle of the cacao bean), fat, starch, inorganic matter, etc.

Coffee.— Its usual adulterations are seeds (roasted peas, beans, etc.), or roots (chicory, dandelion, carrots, turnips, parsnips, etc.), with caramel to color their gray tint. All these are mere diluents; though there are some who actually prefer an admixture of chicory for its flavor, though it gives black, bitter, and muddy grounds. It and the roots may be easily detected by putting a little of the sample into a glass of water: each bit of chicory or other root will be soon the centre of a yellowish-brown cloud, which will rapidly spread till the water is all colored. There are also chemical tests for both tea and coffee, by determining the amount of theine or caffeine, the percentage of matter soluble in water, treatment with hot mineral acids which increase the sugar in coffee but not in chicory, etc.

Confectionery.— The extreme cheapness of sugar has practically put an end to the adulteration of all but the very poorest grades of candies; and those mainly with the harmless terra alba, or pipe-clay.

Distilled Liquors.— Whiskey, brandy, and rum are often purely factitious, being made from caramel and dilute alcohol, and given the characteristic flavors by ethers of various sorts and fusel oil (often left in genuine whiskeys, etc., from carelessness or grudging the cost of purification, and recognizable by its nauseous smell when a little of it is evaporated in the hand).

Drugs.— The adulteration in each case is special, with some article looking like the genuine but inert. This is of course potential manslaughter wholesale, as each prescription made from such materials might cost a life. Unfortunately, a large part of the drugs are imported, and the fraud is probably committed before they come to this country at all.

Dyestuffs.— These are very variously adulterated with cheaper dyes, determinable if at all by expert chemical examination.

Flour and Bread.— Flour is not much adulterated in the United States, though it is in Europe, where the masses are poorer. The chief admixture is ground gypsum or other minerals, which can be detected with the microscope; diluents but harmless. The chief illegitimate additions to bread are alum and sulphate of copper, to whiten it or correct sourness. Alum in baking-powder is not thought objectionable, the heat of baking converting the mixture into insoluble aluminum phosphate; and by itself its chief harm is in disguising the sourness of the bread. Copper sulphate is always dangerous. Both are tested by dissolving gelatine, laid for some hours on a sop of the bread, in a wood-alcohol tincture of logwood with ammonium carbonate, which turns blue for alum and green for the copper salt.

Honey.— Strained honey, a costly article when pure, is heavily adulterated with glucose syrup and sugar, cane sugar, corn-starch, etc. The taste is a better guide to these than any analysis, as that of native flower-fed honey is beyond counterfeiting; but chemical analysis can detect most of them. Still better is the buying of comb honey. The charge has been made by English chemists that American combs are often made of paraffine and filled with glucose; this is most improbable, but a very simple test will decide it. The microscope will show pollen grains in the real, and warm sulphuric acid will blacken beeswax but not paraffine.

Lard.— Hogs' lard is adulterated with stearine, tallow, and cottonseed oil; other vegetable oils, and the lard from animals dying a natural death, are sometimes added, but have no commercial importance if true.

Milk.— The adulterations of this are reducible to five: diluting, skimming, replacing the skimmed cream with cheaper animal fats, coloring to give it the look of that cream, and adding preservatives or correctives to keep it from souring or to sweeten its taste when beginning to turn. Its use as the staff of life for millions of children and invalids makes its purity one of the most exigent demands, and its bad quality or innutritiousness a cause of enormous amounts of disease and death. In some great cities pure milk is simply not attainable for the masses at any price within the means even of ordinary workmen: the dairy districts within reach of the city by train, during any time it will keep sweet and not churn, cannot supply enough for all, and it is inevitably diluted with water, and more or less of it treated with chemicals. To this is added what is not at all necessary, the skimming off of the cream to sell separately; both the first and the last heavily reducing its nutritive value. Still worse, the water used is always liable to contamination from discharges of diseased bodies (diphtheria, typhoid, and scarlet-fever outbreaks have been repeatedly traced to this cause, sometimes merely from cooling leaky cans in the tainted water), from decaying animal or vegetable matter, or from the germs with which street dirt is laden. (The contamination from sores on cows kept in unsanitary conditions belongs to another subject.) As to the effect of the adulterations: Skim-milk is a cheap and valuable food for blood-making protein, as evinced by the cheese made from it; but it should be sold as such, otherwise infants and invalids who need the cream may be injured. The fats simply do not replace the characteristic and valuable qualities of the cream. Of the chemicals, formaldehyde (also used for preserving other foods) is dangerous and should not be permitted. Borax, salt, and carbonate of soda are also used; neither they nor the arnotto used to give the milk a cream color are harmful in themselves, but only as disguising the real quality of the milk sold. Chalk and calves' brains are probably jocular figments.

The method of testing for dilution is by the lactometer, to determine specific gravity, which is lowered by admixture of water; in exact reverse, it detects skimming (which increases specific gravity by removing the lighter cream) by showing normal specific gravity when looks and taste are inferior. Skimming is also inferred from increase in transparency, as indicated by the lactoscope: opaque normal milk needs thinning with a certain percentage of water before a dark object, or black line drawn on a

white surface, will show through; the less water a given sample needs for this visibility, the less cream it contains. For more precise determination the chemist finds the amount of solids in a sample by evaporating a mixture of milk and heated sand and weighing the residue; the amount of fats, by dissolving them out with ether and evaporating. Watering may often be detected by testing for nitrates, which milk does not contain and most water does, and contaminated water almost always. The detection of animal fats used to replace cream is not easy, though the butyrates have some individual qualities.

Mustard.— This is perhaps the most heavily and universally adulterated article in the market: only a small percentage of it is pure, and even that has had its abundant essential oil, which makes it difficult to grind, expressed from it. For one harmless adulteration the public is responsible, as for butter-color and pickle-green: that of turmeric or ochre to give it the bright yellow demanded by customers, while real mustard is very dull. But it is regularly diluted with starch,— wheat, corn, or rice,— rape-seed, flaxseed, old turnip- or radish-seed unfit to plant. For starch, easy tests are iodine, which turns it blue, and its thickening in boiling water; for mineral matter, the chemist determines the amount of ash. For the others, though the microscope is useful, the best remedy is to pay for a known brand,— which indeed is best for all.

Oil.— A large part of the so-called olive oil of the market is cottonseed, peanut, or mustard oil, or greatly mixed with it: probably the equal in quality and taste of the genuine (as it is indistinguishable), but a fraud as exorbitant in price through deception. The use of lard oil is probably a figment, that of petroleum oils certainly so. Tests: Nitric acid colors the adulterant oils, but not olive, and sulphuric acid raises their temperature higher.

Pickles and Canned Goods.— The public demand for bright green pickles has been gratified by boiling them in copper kettles with vinegar and some alum, the vinegar forming the highly poisonous acetate of copper with the kettle, and coloring the pickles green: it is easily tested by dipping a piece of clean bright iron in the pickle, which will gain a coating of copper if it is present. The same process is said to be gone through with peas; and even the copper salts directly added, which would be a basis for a criminal prosecution. The presence of metallic salts from the can — which would result from careless canning and not deliberate addition — has been thoroughly demonstrated to be harmless: oxid of tin would make the canned food too nauseous to eat long before it reached even a medicinal proportion, and oxid of lead has not been found in any quantity. By far the greatest danger in canned foods is bad canning, causing putrefactive ptomaines to be created, which have caused many deaths.

Preserves, Jams, Jellies.— Gelatine and glue are often used to help the fruit to jelly (not always an easy thing to assure even by experts), and are often not restricted to the amount needed: the goods are also artificially colored, and flavored with so-called «fruit oils,» chemical analysis being needed to determine the constituents. Zinc oxid has been found in preserves, from its use to make covers of jars air-tight.

Spices: Nutmeg, Pepper, Cinnamon, Mace, Cloves, Allspice, etc.— Whole spices are generally thought safe from adulteration; but they are not, as inferior members of the same species may be substituted for them, with immense loss of quality, exactly as if crab-apples were sold for dessert apples. Thus, wild nutmegs are often sold for the cultivated ones, and cassia almost always for cinnamon. The method of detection is to know the genuine. For instance, the best nutmegs are about an inch long and shaped like a damson plum, weigh one-seventh to one-fifth of an ounce, and exude oil liberally when pricked with a pin; the wild ones are small and pointed and have less oil and fragrance. The genuine or Ceylon cinnamon is a thin small roll, of delicate fragrance which lasts long in the mouth, and tears rather than breaks; the cassia or Chinese cinnamon is much coarser and thicker, breaks but does not tear, is rather mucilaginous when chewed, and has a strong woody flavor. In 1875 the United States imported $4,073 worth of cinnamon and $279,250 worth of cassia, or nearly seventy times as much. Cloves are adulterated by making them absorb water, of which they will take up a great deal, to increase their weight.

The immense adulteration of ground spices makes their convenience a costly purchase. At the outset, sawdust and starch are added even to the best, to absorb the oil which makes them difficult to grind; and it rarely stops there. Of 12 specimens called « ground cinnamon » examined by the New York Board of Health in 1883, only three contained any cinnamon whatever, and even those were largely mixed with cassia and sawdust; the others were almost entirely composed of those ingredients, two were sawdust with a very little cassia, and one was pure sawdust. Seventy per cent of the allspice, 70 per cent of the pepper, 82 per cent of the cinnamon, 57 per cent of the cassia, 76 per cent of the cloves, and 66 per cent of the ginger, was adulterated. The most universal adulterations are starch for bulk, mustard for pungency, and turmeric for color. Black pepper demands a special note, as it is the exception rather than the rule to find it pure. A large percentage of the samples examined in the past have contained no pepper at all. « Pepper dust » (the sweepings of warehouses, in trade a regular article of sale as « P. D.»), mustard husks, ground wheat, corn, or rice, capsicum, and even gypsum and sand, have been found in it. Red or cayenne pepper is much purer than black pepper and is mainly adulterated with flour.

Sugar.— White cane sugar has become so cheap that it does not pay to adulterate it, and the old adulterants like marble dust, terra alba, etc., have practically disappeared except in cheap confectionery. Sand was never much used except in brown sugar (4 per cent has been said to be unavoidable in Manila sugars, but any percentage is indictable if the direct addition can be proved), and glucose from sawdust has taken its place: equally healthful with cane sugar, but of course a fraud as less sweet and a deception.

Tea.— Owing to its cost and the difficulty of judging its quality by the eye or taste (Adam Smith has some acute remarks on this), tea has always been a favorite article of adulteration

from its introduction into the West; fortunately, more than most products the price is an index of the quality, and it is easy to procure a good article by paying for it, the supply of good quality not being limited by nature as with foreign wines. It has the distinction of having had a special law passed to prevent its adulteration, and for the most curious reason imaginable: the Act of 17 Geo. III. alleges that the admixture of the leaves of sloe, ash, elder, and other trees and shrubs with it was working great injury to the timber and undergrowth. Being a luxury whose cost presses heavily on the very poor, its substitutes within the means of that class have usually none of the characteristic properties, good or bad, of the genuine, and are mere flavored warm drinks; curiously, the only poisonous adulteration ever alleged against it (groundlessly), that of obtaining its green color from copper pans, was against the very costliest brand of all. It has been said, however, that tea was « faced » with Prussian blue and indigo; if so, the time has gone by. But the stuff sold to the poor, besides spent tea-leaves, and those of various plants as above, has been found to contain masses of sheer dirt, sweepings, brick-dust, etc., unwholesome and liable to contain disease germs. See TEA.

Tobacco.— Color and flavor are often given to inferior grades by artificial means. No leaf is known which will counterfeit the tobacco leaf outright. Snuff, however, lends itself readily to debasement by colored powder, and lime and chromate of lead have been found in it.

Vinegar.— The most usual form of adulteration is thinning down with water, then restoring the lost strength with sulphuric, muriatic, nitric, or other cheap mineral acids. The first is easily detected by the considerable precipitate when barium chloride is added; the second by a white flocculent precipitate on adding a few drops of solution of silver nitrate. Nitric acid needs special chemical tests.

Wines.— Naturally their chief adulterants are water and alcohol, to increase bulk or strength; colors and flavors, astringents, etc.,— caramel, logwood, glycerine, syrups, etc.,— to give artificial qualities resembling reputed wines; salicylic acid to prevent souring; gypsum to precipitate organic matters that muddy the wine (the latter injurious as likely to turn into acid potassium sulphate); sugar in the must, to increase the alcohol, etc. Natural colors like fruit juices and cochineal are harmless; aniline colors not always. The chemical tests are too special to be detailed in a popular work. It should be said, however, that by far the leading adulteration consists in the wine not being real fermented grape-juice at all: this applies only to foreign wines, the American being generally pure, and practically the only pure wines at moderate price on the market. Real wine from foreign vineyards is a costly article, and the better grades are pledged years ahead to the great foreign courts, noble houses, and private European buyers. Cheap foreign wines should be understood from the outset to be made either from exhausted grape-skins or raisins treated with alcohol and water (it is not for dessert use that the great majority of the California raisin crop is exported to France), or from pear-juice (much the greater part of the so-called French « champagne » in America being perry).

(Ellen H. Richards, ‹Food Materials and Their Adulterations,› an admirable household manual of food selection and preparation, Boston 1886; ‹Health in Diet, Health Exhibition Literature,› Vol. V., London 1884; Battershall, ‹Food Adulteration and its Detection,› New York 1887; Wedderburn, popular treatise on ‹Food Adulterations,› Washington 1890; Wiley, Richardson, Crampton, and Spencer, ‹Foods and Food Adulterants,› 7 parts, Washington 1887–92; etc.)

Adultery, unlawful intercourse between two married persons not standing to each other in the relation of husband and wife, or between a married person and another unmarried. In the former case, it has been called double, and in the latter single adultery. Unlawful voluntary sexual intercourse between two persons, one of whom at least is married, is the essence of the crime in all cases. In general it is sufficient if either party is married, and the crime of the married party will be adultery, while that of the unmarried party will be fornication. In the United States there is a wide diversity in the laws relating to this offense. In some States it has been made a crime, while in others civil proceedings are allowed substantially similar to those of the English law. Varied punishments, mostly of a very severe character, have in nearly all countries and ages been inflicted on those who have committed this offense. In some cases it has been deemed lawful for a husband or the woman's father to kill the guilty person if taken in the act. By the law of England the slaughter of the offending parties in such cases is deemed manslaughter of a not very aggravated sort. In English law the act is punishable only by the censure of the ecclesiastical courts, but when committed by a wife it is regarded as a civil injury, and an action for criminal conversation may be brought by the husband against the paramour. Adultery is now considered in England a ground for total divorce.

Advance Guard. See TACTICS.

Advaita, ä-dwaī'tä, a philosophical school of India, founded by Sankarûjûrya (or Cankarâcârya), who flourished about the middle of the 8th century A.D., or earlier. Its principal doctrines are that the human soul is not essentially different from God, but that it is imprisoned in the body from which at death it is released to return to the impersonal God, and that the material world is not different from God. Its adherents are called Advaïtavâdin, or Confessors of Monism.

Ad Valor'em (« according to value »), a term denoting the method by which customs taxes are determined at a percentage of the value of the imported article at its place of export, on the seller's oath and the appraiser's estimate. Theoretically, this is much fairer than a specific duty (on a unit of measure, as pound, yard, bushel, bale, etc.), since the costlier pay their equal percentage with the cheaper; but in practice, it has serious drawbacks, annoys both sellers and government much, defrauds the latter somewhat and its people a great deal. Values are unstable, the exporter is interested to understate them, and the officials are eager to scent fraud, whence much friction and many lawsuits. As to the last item, general tariffs are apt to produce an appearance of moderate aver-

age by equating a low duty on grades of slight consumption with a high one on those chiefly used; a deception impossible on specific duties, which at least must declare themselves. The customs officers much prefer these also. The United States tariffs are of both kinds, some articles having a combination of the two.

Advancement, in law, is a gift by anticipation from a parent to a child of the whole or a part of what it is supposed such child would inherit on the death of the parent. An advancement can only be made by a parent to a child (2 Jones, 137), or in some States by statute to a grandchild. (4 Kent Comm. 419.) The effect of an advancement is to reduce the distributive share of the child by the amount so received, estimating its value at the time of receipt. In some States, however, the child has his option to retain the advancement and abandon his distributive share.

Advancement of Learning, The, by Francis Bacon, 1605, the original title being ‹Of the Proficience and Advancement of Learning, Divine and Human.› This book, received with great favor by the court and by scholars, was afterward enlarged and published in Latin with the title ‹De Augmentis Scientiarum,› as the first part of a monumental labor, ‹The Instauration of the Sciences,› of which the second part was the still famous ‹Novum Organum,› on which Bacon's fame as a philosopher rests.

Advent, the period of some weeks before the Nativity, observed in all the apostolic churches as a season of solemnity of emotion and action, marriages and public amusements being interdicted or reprobated; in the Roman Catholic Church also a season of fasting and penance. In the Western Churches — Roman, Lutheran, English, and Protestant Episcopal — it is of four weeks, beginning the Sunday next after 26 November, or that nearest St. Andrew's Day (30 November); in the Greek Church it is six weeks, beginning 11 November, St. Martin's Day. Our first notice of it is in the 6th century, at the Synod of Lerida (524); and two sermons on it in 542 show that it was then in general observance. In that century also the Eastern and Western Churches, following the Nestorians, made it the beginning of the ecclesiastical year instead of Easter. Its four Sundays were believed to have been introduced into the calendar by Gregory the Great; and to have reference to Christ's fourfold coming early spoken of — in the flesh, at the hour of death to his faithful followers, at the fall of Jerusalem, and at the day of judgment. On these grounds the gospels were chosen for the four Sundays. Its ordering was settled in the Western Church by Charlemagne's « Homilarium.»

Advent, Second. See MILLENNIUM.

Adventists (often spoken of as « Second-Adventists,» and formerly as « Millerites »), a sect founded by William Miller (q.v.), beginning with his preaching in 1831, on no doctrinal creed or theory of ritual or church government, but the belief in the speedy coming of Christ to reign on the earth: a persuasion shared by so many hundred thousands in many sects,— forming indeed an essential foundation-stone of one considerable body, the Catholic Apostolic,— that it hardly seems a basis for a separate church; and in fact it is not one, but six, each with a special creed and organization. Mr. Miller's study of the Biblical prophecies, especially the Book of Daniel, had convinced him that the coming was to be between 21 March 1843 and 21 March 1844; after this time had passed, he was led to believe that he had erred by a year through mistaking the Jewish year for the Roman, which would be 1844, the exact date (the prophecies having given it even to an hour if we understood them) being 24–5 October. Vast multitudes, many being first baptized by immersion, assembled in different places (one group on an island in the Connecticut River above Hartford) to welcome the occasion and the Saviour (not however in ascension robes, as usually stated, or not generally); one lady went to Palestine to meet her Saviour first; some in the fervor of their faith gave away their property; and the excitement scarcely flagged till far into November. There was a « Shut-Door » faction, who believed that on the tenth day Christ had shut the door, and the « tenth-day » debate and literature were considerable; one of « Feet-Washers"; and in the shock of disappointment, the Shakers received considerable accessions. On 20 April 1845 Mr. Miller called a convention at Albany, N. Y., of the still faithful (over 50,000 in all), which issued a declaration of belief and adopted the name of Adventists. The declaration was that Christ will come soon, but at an unknown time; that the dead both just and unjust will arise, and with the resurrection of the saints the Millennium will begin; but that there is no promise of the world's conversion, and the saints do not enter into their inheritance at death. Mr. Miller died in 1849, but the sect has maintained its vitality with remarkable persistence in the face of repeated disappointments, several other periods having aroused wide hopes among them. They now, however, in general fix no specific date, but like their fellows in other Churches await the hour in the Lord's good time. Their Church government is congregational, save that the Seventh Day Adventists and the Church of God (originally one) have a general conference which is supreme. Their baptism is by immersion.

Their branches are: (1) The Evangelical Adventists, formed 1845, who believe in the resurrection of the saints first to eternal bliss, and the wicked last to eternal torment, but that all are conscious after death while waiting. (2) The Advent Christians, organized 1861, who believe that the dead are unconscious, that the wicked are punished by annihilation, and that salvation is free to all who meet its conditions before death. They are chiefly located in New England, and their literature is published by the American Millennial Association, Boston. They maintain home and extensive foreign missions; the former aided by the "Helpers' Union," a woman's auxiliary. (3) The Seventh-Day Adventists (q.v.), formed in 1845, who believe as (2) concerning the dead; that the gift of prophecy still exists, and was accorded to Mrs. Ellen G. White; that the United States is the Two-Horned Beast; that 1843 was a real fulfillment of prophecy, namely, the « cleansing of the sanctuary » and the beginning of the « investigative judgment »; and that total abstinence, vegetarianism, and hygiene are part of religion. This is by far the strongest of all. Its headquarters are at Battle

Creek, Mich., and its members are spread throughout the United States, being especially strong in the West, and numerous in other countries as well as America, having a missionary society active in all parts of the globe. It has seven publishing houses, in America, Europe, and Australia, and sanitariums and seminaries in a number of States. Its members are spread throughout the Atlantic States. Four camp-meetings are held each year, in New England and Virginia. Home missions are supported by an adult and a juvenile society. The publishing house is at Springfield, Mass. (4) The Church of God, formed 1864–5 by a split from (3), on refusal to hold Mrs. White inspired or the United States the Beast; otherwise its beliefs are the same. It is located chiefly in the West and Southwest, and has a publishing house at White Cloud, Mich., and a sanitarium at Stanberry, Mo. (5) The Life and Advent Union, organized 1860, which believes that the wicked never wake from their sleep of death. (6) The Churches of God in Jesus Christ (« Age-to-Come Adventists »), who believe in the establishment of the kingdom of God on earth, with Christ as king and the saints partakers with him, the annihilation of the wicked, and the restoration of Israel. They are established in various parts of the United States and Canada.

The following is a summary of the size and activities of the various United States Adventist bodies in 1900: —

Denominations.	Churches.	Ministers.	Communicants.
1. Evangelicals	30	34	1,147
2. Advent Christians ...	610	912	26,500
3. Seventh Day	1,494	386	57,539
4. Church of God......	26	19	647
5. Life and Advent Union	28	60	3,800
6. Churches of God in Jesus Christ	95	94	2,872

Adverb. See GRAMMAR.

Adverse Possession, a possession against any other claimant. It is the enjoyment of land, or such estate as lies in grant, under such circumstances as indicate that such enjoyment has commenced and continued under an assertion or color of right on the part of the possessor.

In a majority of the States of the Union, when such possession has been actual and has been adverse for 20 years, of which the jury are to judge from the circumstances, the law raises a presumption of a grant. This presumption, however, arises only when the use or occupation would otherwise have been unlawful.

Such possession, however, must be open, notorious, visible, exclusive, and continuous. But possession is not adverse when both parties claim under the same title, as if a man seized of certain land in fee have issue two sons and die seised, and one of the sons enter by abatement into the land, the statute of limitations will not operate against the other son; for when the abator entered into the land of his father, before entry made by his brother, the law intends that he entered claiming as heir to his father, by which title the other son also claims.

Adversity Hume. See HUME, JOSEPH.

Advertisements of Elizabeth, orders issued by Matthew Parker, Archbishop of Canterbury, in 1566, to enforce dignity and uniformity in the conduct of Common Prayer and the administration of the sacraments; prescribing the wearing of the surplice and college cap by the clergy, and of the cope in cathedrals and collegiate churches. They were so entirely in accord with Elizabeth's known views that the Archbishop had no doubt of her sanction; but after a year's waiting and copious correspondence with her minister Cecil (Burghley), he could not extract an official guaranty and was obliged to assume personal responsibility. Their modern importance springs from the quarrel in the English Church over ritual and their varying interpretation by the High and Low parties. In the Ridsdale case of 1877, the latter, headed by Lord Selborne, held that they prescribed absolutely the vestments to be worn, and were infringed by additions; the former, through James Parker, held them merely a minimum for decency.

Advertising. From French *Avertir,* to notify. Originally, advertising implied mere publication, a notice for an individual, or class, such as legal advertisements. The word, however, is now generally applied to the advertisement of merchandise to the public at large, through periodicals, circulars, posters, painted signs, electrical display, etc. In its present sense advertising is a powerful and legitimate force in the commercial world and in the distribution of commodities, and it has been designated as the literature of persuasion. Its volume in the United States figured in dollars is greater than any other line of business except banking, insurance and transportation.

History of Advertising.— The rudiments of advertising as it is practised to-day for the promotion of commerce can be traced back as far as commerce itself. With the invention of the rudest forms of writing came advertisements such as the rewards for runaway slaves. These were written on papyri and well-preserved copies have been exhumed at Thebes. Before writing was developed advertising by means of criers and sign-boards existed. The latter have been used in all ages for the information of the illiterate. Shops in ancient Pompeii had terra-cotta signs, showing a goat to denote a milk-seller's stall, or two men at sword-play to indicate a fencing school. Old tavern signs like the « Star and Garter » are a mediæval form of the same species of advertisement. All shops in London and Paris had such picture-advertisements in the Middle Ages, so that servants unable to read might find them. Until the invention of printing advertising was necessarily of this primitive character. But since the 16th century it has steadily kept pace with the increase in periodicals and books. The oldest newspaper advertisement preserved appears in a German newsbook of 1591, and is a book notice. The first newspaper traceable in France (1612) was partly an advertising medium. The first English newspaper appeared in 1622, and the first advertisement 30 years later. But before that the puffing of books, shows, cure-alls and quacks by posters, processions, etc., was very common. The introduction of tea, coffee and chocolate into England is recorded in old newspaper advertisements (1652–58). Addison's «Tatler» No. 224 (1710) is devoted entirely to descriptions of advertisements of that day in the public press, and tells of methods of exploiting

pills, plasters, cosmetics, books, houses for rent and advertising for lost animals and runaway wives. Fifty years later (1759) Dr. Johnson thought that "the trade of advertising is now so near to perfection that it is not easy to propose any improvement." The first newspaper advertisement in America appears in the Boston 'News-Letter,' of 1704. Notices of shipping and rewards for slaves were numerous in the 'New England Weekly Journal' (Boston) of 1728, and shortly after this American newspapers began to carry miscellaneous trade advertisements.

In Great Britain advertisements were heavily taxed until 1833, an impost of 3s. 6d. being levied on each one appearing in a newspaper, though it might be but a laborer's advertisement for work. Upon the abolition of this tax advertising immediately began to grow. To-day Great Britain probably stands next to the United States in the extent of its advertising expenditure. The London and provincial newspapers are heavily patronized, while outdoor advertising is more extensive and less sightly than in this country. English magazines, though numerous, have never been developed as advertising mediums to the extent that the American have. In advertising practise British tradesmen and manufacturers respect and study American advertising methods, adapting many of our devices to their own needs. In Continental Europe advertising finds its chief outlet in the newspapers, which often have tremendous circulations, and by means of outdoor posters and bulletins. The latter forms of advertisement are generally controlled by governments on the Continent, and not only yield a revenue to the State, but are regulated as to size, location and display. While France, Germany, Italy and other countries have numerous weekly and monthly reviews, none of them have ever attained the importance of leading American magazines as advertising mediums. Great Britain and the continental countries have better facilities for the transportation of merchandise parcels through the posts, and it might be thought that on this account some system corresponding to our mail order advertising would have been developed. But mail order advertising is limited there, probably because most of the population is in close touch with distributing centers, and also because the mass of the people not so evenly prosperous as American farmers, have a smaller purchasing power.

The real development of advertising as a factor in the distribution of commodities may be said to have begun only with the appearance of the steamboat and railroad, the modern postal system and the telegraph. Its rapid growth since then, especially in the United States, where the great distances between producer and consumer lessen direct dealing, would seem to indicate that it is a legitimate wheel in distributive machinery rather than a form of aggrandized puffery. In this sense, advertising is but little more than 50 years old. Before then, it had chiefly a curious interest. A full and entertaining description of early advertising will be found in Sampson's 'History of Advertising from the Earliest Times' (London 1874).

Development of Advertising.—Advertising in the modern sense was first sparingly employed by retail merchants in large cities. About 1840 improved postal facilities in the United States broadened newspaper circulation and brought into being the earliest trade, denominational, agricultural and general periodicals of national circulation. These made it profitable to advertise over wide territory. Soon there were firms, chiefly patent nostrum makers, whose chief expenditure was for advertising, and the value of the new force was appreciated by charlatans, quacks and swindlers to such an extent that the public soon learned to distrust advertising. For more than a generation it was not considered reputable by the great majority of legitimate business houses. The power of advertising as a force in merchandising, however, eventually brought reputable interests into the field. The swindler began to retreat. Among the first classes of manufacturers to advertise widely were makers of novel commodities, such as sewing machines, typewriters, bicycles, baking powders, infant foods, etc., then quite new for the most part. In the period from 1880 to 1890 the charlatan was practically forced out of American advertising mediums as legitimate business increased in them, and in the period from 1890 to 1905, with public confidence gained, the growth of both advertising and publications in the United States has been so great that publishing and printing now rank seventh in the country's industries, being exceeded only by iron and steel, slaughtering, foundries and machinery, lumbering, milling and men's clothing. Where formerly the novelties of commerce were advertised, it is now the staples that predominate, such as shoes, flour, cereal foods, clothing, vehicles, etc. The advertising revenue of leading publications is to-day so important that most publishers censor advertising, and investigate a doubtful advertiser before his announcement is inserted. The practise of the publisher making good to readers any loss they may incur through a swindling advertisement is becoming common in this country, and few losses occur. Moreover, the Government has thrown safeguards around advertising, and through the Postoffice effectually prevents swindling operations by denying the use of the mails to an advertiser whose methods will not bear investigation. Advertising has had an immense influence upon the lives of the people, for it not only increases the standard of living and health by introduction of modern conveniences such as baths and sanitary appliances, heating and lighting apparatus, the spread of means of culture, the encouragement of travel, etc., but also tends to improve the quality of commodities without a corresponding increase in cost. Competition in advertising takes the form of price rivalry much more rarely than might be presumed. Advertisers seeking to create national demand for commodities sold under their trade-brands, compete rather in offering excellent staples, assuring purity and marketing in sanitary packages. Advertising has resulted in the invention and use of dust, germ and air-proof cartons, boxes and containers. Formerly it was a kind of puffery, but at present the widest advertising is characterized by the completeness with which it presents information, and the logical reasoning by which it seeks to persuade readers. In the decade from 1895 to 1905 advertising in the United States has outgrown that of every other nation in volume, and has also been conspicuous for its division into special channels, following

The Daily Advertiser.

New-York, Saturday, March 7, 1795. Printed by FRANCIS CHILDS, Printer to the State, No. 71, Pine-street, corner of Water-street. Vol. XI.—No. [illegible]

SWEET OIL,
[illegible]

SUYDAM and HEYER,
[illegible]

FOR SALE,
[illegible]

James Bradish, [illegible] Water Street,
[illegible]

For Sale on board Sloop Maria,
[illegible]

Pimento for Sale.
FORTY [illegible] by LAMMOND & Co. [illegible] February 21.

FOR SALE,
[illegible]

MALLIDAY & DURAND,
[illegible]

FOR SALE,
[illegible]

FOR SALE,
[illegible]

Landing this day at Crane Wharf,
[illegible]

FOR SALE,
[illegible]

FOR SALE,
[illegible]

GENUINE DRUGS & MEDICINES,
[illegible]

William and James Bailey,
[illegible]

[illegible]

THOMAS BLOODGOOD,
[illegible]

[illegible] Barrels of Virginia FLOUR,
[illegible]

LOOMIS & TILLINGHAST
[illegible]

House and Garden at Mount Pitt,
[illegible]

Hyson, Souchong and Congo Teas,
[illegible]

For Freight or Charter,
To a Port in Europe or the Mediterranean,
The Swedish Brig [illegible]
[illegible] Apply to GOUVERNEUR & KEMBLE.

FOR AMSTERDAM,
The Brig OLIVE BRANCH,
[illegible] BROTHERS, CO[illegible]

FOR HAMBURGH,
[illegible] No. 191 Water Street.

Wanted to Charter,
[illegible]

For Sale or Charter,
[illegible]

For Amsterdam,
[illegible]

For Havre-de-Grace,
[illegible]

WANTED
[illegible]

For KINGSTON, Jam.
[illegible] JOHN [illegible]

EDWARD GOOLD
[illegible]

TO be let, sold, or exchanged for [illegible]
[illegible]

Thos. Farmer & Co. No. 19 Front Street,
[illegible]

CHARLES L. CAMMANN,
[illegible]

GINSANG,
[illegible]

PRIME St. Croix Sugar and Rum,
[illegible] NICHOLAS CRUGER.

FOR SAVANNAH,
[illegible]

For MADEIRA
[illegible]

FOR SALE
The Brig NANCY,
[illegible]

Wanted to Charter
[illegible]

FOR SALE.
[illegible]

NANKEENS
[illegible]

THE PARTNERSHIP of HENRY [illegible]
BROTHERS COSTER and COMP.
[illegible]

COPARTNERSHIP.
[illegible]

This Day will be Landed,
[illegible]

STEPHEN PATERSON,
[illegible]

This Morning will be Landed,
[illegible]

RICE.
[illegible]

Landing This Day,
[illegible] SIMON NATHAN.

LITERARY MAGAZINE,
[illegible]

Superfine and Fine Flour,
[illegible]

LAWRENCE and WHITNEY.
[illegible]

COPARTNERSHIP
[illegible] HENRY SADLER & Co.

PEPPER.
[illegible]

For Cape Nicola Mole,
[illegible]

JOHN M'VICKAR,
[illegible]

SUGAR and COFFEE.
[illegible]

[illegible]

WILLIAM and JOHN HARVEY
[illegible]

THOMAS WHITE,
[illegible]

ROLL'D IRON,
[illegible]

INDIGO.
[illegible]

NICHOLAS COOKE,
[illegible]

FOR SALE,
[illegible]

JOSEPH BLACKWELL,
[illegible]

Landing this Day at Burling Slip,
[illegible]

FOR SALE,
[illegible]

GUERLAIN and Co.
[illegible]

For sale by Frederick [illegible]
[illegible]

This Day will be Landed,
[illegible]

FOR SALE,
[illegible]

For sale by Maxwell & Davis, distiller
[illegible]

GEURLAIN and Co
[illegible]

To be Sold at Private Sale,
[illegible] Wm. B. GIFFORD.

A Vendre, a Main Ferme.
[illegible] GUILLAUME B. GIFFORD.

the lines of the various periodicals and conditions of demand for commodities.

Retail Advertising embraces the announcements of merchants, large and small, in their own communities, from the full page in each day's newspapers employed by great department stores to the small announcements once or twice a week of the minor shopkeeper. This form of advertising is really a species of news, prepared daily, and is of such interest to the public that many readers take newspapers for their store advertisements, and the journals which carry most of these have the largest circulations. Merchants also publish store news by means of circulars through the mails, minor local journals, programmes, bulletins, posters, etc.

General Advertising is the general term describing exploitation intended to reach the public nationally, or in a group of states. It is found chiefly in magazines and reviews, and in daily newspapers. Street cars, billboards and bulletins are employed as accessories. General advertisers include large manufacturers of food articles, soaps, musical instruments, clothing, beverages, tobacco, household and office supplies, furniture, plate, jewelry, sanitary appliances, etc., as well as the great insurance, steamship and railroad companies, cities and villages seeking population, banks and trust companies, and so forth. This is easily the largest branch of advertising, and the one most influential in distribution. It acts as a stimulus to the local merchant's efforts, and is so wide in scope as to touch every class and interest of the nation, however remote.

Mail Order Advertising is the term applied to a form of exploitation peculiarly American. When the newer communities of the West were insufficiently supplied by their local merchants, several intelligent merchants in Chicago, a city situated geographically for this form of trade, began to advertise commodities to be forwarded direct to consumers by freight and express, receiving orders and remittances through the mails. This was the beginning of "mail order" advertising. Several of these merchants have built up businesses with a gross annual income of $25,000,000 or more, selling practically everything in the way of supplies, machinery, food, clothing, etc., direct to the consumer. Thousands of small advertisers operate with a few commodities through the mails, and many local merchants conduct mail order departments. Mail order advertising is found in the magazines, the farm and religious press, the newspapers, and in a class of cheaply printed periodicals known as "mail order journals," having enormous circulations among people on farms and in villages who are not reached by more costly magazines or daily papers. A large volume of mail order advertising is also done through catalogues and printed matter sent through the mails.

Agricultural Advertising is a form of publicity similar to mail order advertising, but which appears chiefly in farm periodicals and exploits machinery, fertilizers, farm animals, stock food, building materials and farm supplies.

Trade Journal Advertising appears in the numerous special publications devoted to manufacturing, retail and wholesale, commerce, finance, medicine and the professions, mining, transportation, etc. Its object is to acquaint local merchants with commodities manufacturers wish to distribute, to inform engineers and superintendents of manufacturing plants about new machinery, and, generally, to maintain that great organization which produces and handles commodities up to the point where they pass into the consumer's hands.

Advertising Mediums.— In the United States advertising may be divided roughly into four groups, represented by the mediums used: Periodical advertising, outdoor advertising, street-car advertising and mail advertising.

Periodical Advertising includes newspapers, magazines, reviews, trade, denominational and farm publications, periodicals printed in foreign languages, theatre and concert programs and other publications, of which there are not less than 23,000 of all kinds. In 1900 the output of printing and publishing in this country was valued at $350,000,000, of which, it is estimated, fully $200,000,000 represented revenue from advertisements in periodicals and the printing of advertising matter. This item of expenditure is increasing so rapidly that it was estimated at $275,000,000 for 1905. Advertising in periodicals exceeds receipts from subscriptions by $30,000,000. During the 20 years from 1880 to 1900 the increase in advertising receipts of American periodicals was over 40 per cent. In the four States that publish the greatest number of periodicals — New York, Pennsylvania, Massachusetts and Illinois — the receipts from advertising in 1900 were over $52,000,000. The advertising revenue of some of our largest newspapers runs into millions of dollars yearly. Magazines have shown the greatest growth in numbers, circulation and advertising patronage the past decade. In November, 1904, 31 leading monthly magazines in the United States published a total of 3,128 pages of advertising, representing, at an average of $21 an inch, an income of more than $1,000,000 per month from this source. More than 7,500 separate advertisements were represented, and 2,000 separate business houses, with an average expenditure of $500 each for the month, or $6,000 per year. It is held to be a safe rule to spend 5 per cent of the selling price of a commodity in advertising, so that this advertising for a single month in 31 publications would have to return a gross amount exceeding $20,000,000 to be profitable, or nearly $250,000,000 yearly. While the largest newspaper circulations seldom exceed 300,000 copies, daily, the circulation of several monthly magazines is more than 1,000,000 copies per issue, and of one weekly more than 800,000 copies per issue.

Outdoor Advertising includes posters and placards pasted on billboards and barns, painted signs on barns, fences and walls, as well as specially constructed bulletin boards in large cities which are electrically illuminated at night, the erection of advertisements about buildings in process of construction, the use of advertising along railroad lines and at populous seaside resorts, etc. As much as $10 per square foot has been paid for the privilege of advertising on a wall in New York City. Electric signs, with advertisements outlined in incandescent lamps, are an important form of expenditure for outdoor advertising. The largest advertisement of this sort in the world is a single word on a New York building, with letters 60 feet high, visible to 50,000,000 passengers on ferries each year. Advertising of this character adds to the attractiveness of a city by its diffusion of light

through the main streets at no cost to the public. Billboards and other outdoor advertising are more often charged with abuses and unsightliness than any other form, and in some cities are prohibited in the vicinity of parks by municipal regulation. They have never come under control to the extent common on the Continent, and in comparison with the outdoor advertisements of London are perhaps pleasing. Outdoor advertising is thought to be effective in reaching persons not habitual readers of newspapers, as well as to lay emphasis upon newspaper and magazine advertising by repeating the names of commodities more fully described in the press. It necessarily affords no opportunities for description of articles, but is confined to repetition of brands and trademarks.

Street Car Advertising is a medium that has become prominent in the United States since the introduction of electric traction and the spread of trolley lines through cities and suburbs. An enormous population is carried in these vehicles — more than 5,000,000,000 cash fares are paid on trolleys yearly, and perhaps two-thirds of these represent an extra ride in the shape of a transfer. It is possible to maintain an advertising card in the 32,000 cars throughout the United States, covering about 400 towns and cities, for $150,000 a year, and in point of the number of persons who can be reached for a given sum the trolley, elevated and subway lines are said to offer the cheapest form of advertising. Car advertising in New York City, it is claimed, has a national circulation owing to the fact that 250,000 persons from all over the country are constantly in the metropolis. More matters may be printed on a car card than on an outdoor poster, and while there are few instances where large advertisers have attained success through the use of billboards alone, quite a number have confined their operations to street cars with profit. As a rule, though, advertising aims toward a balanced effect in magazines, newspapers, cars, billboards and printed matter.

Mail Advertising.— In 1679 a London haberdasher gave to each customer who purchased goods to the value of a guinea a printed list of his stock, and this was regarded as a dangerous innovation because, if followed generally, it would result in the investment of too much tradesmen's capital in printed bills. From this humble beginning the use of circulars and catalogues has grown to a point where, at present, in the United States, every second letter carried through the mails is an advertising letter, and for every periodical posted there is mailed a catalogue or brochure. Postage on advertising matter aggregated between $25,000,000 and $30,000,000 in 1904, and this perhaps represented only one-tenth the cost of compiling and printing such advertising. Mail advertising takes many forms, from the leather-bound catalogue of 500 or more pages to the humble postal card. Every general advertiser has descriptive matter in booklet form which is mailed freely to those who express interest in his magazine or newspaper advertising, and in many instances the periodicals are used only to excite such interest, printed matter being relied upon to tell the whole story of such complicated apparatus as an agricultural implement, heating furnace or piano-player. Many advertising letters are sent out to lists of persons who may be interested in certain commodities, either printed in imitation of typewriting or actually written on a typing machine. Mail advertising also embraces the distribution at regular postal rates of small periodicals devoted to the interests of a manufacturing or merchandising house. There are hundreds of these personal business organs, some of which have been of sufficient interest to enlarge into standard magazines. Mail advertising also includes the distribution of what are known as "advertising novelties," ingenious or useful trifles ranging from puzzles to match-boxes, and comic cards to desk calendars, all bearing the name of an advertiser. Blotters, calendars, almanacs, reproductions of paintings and many other forms of printed advertising, upon tin, cardboard, paper, wood, leather, cloth, bark, porcelain, glass and other substances travel through the mails. This is the most costly form of advertising known, in proportion to the number of persons that can be reached for a given expenditure, but as most of this matter is sent to persons thought to be directly interested, it often pays a larger return than advertising distributed promiscuously through periodicals, etc.

Advertising Agencies.— Soon after advertising began to be used nationally instead of locally it was found convenient to put details of corresponding with newspapers, arranging rates, writing the advertisements, seeing that they were properly inserted, etc., into the hands of a new functionary who then sprang up — the Advertising Agent. The first advertising agent to open an office for the reception of advertisements in this country was Volney B. Palmer. He began business in Philadelphia in 1840, and subsequently established offices in Boston and Baltimore as well. Before this, however, the advertising agent was known abroad, for Balzac mentions ("Le Deputé d'Arcis") as among the tenants of a Paris rookery in the thirties, "women of the town, still-born insurance companies, newspapers fated to die young, impossible railway companies, discount brokers and advertisement agents who lack the publicity they profess to sell — in short, all description of shy or doubtful enterprise." When national advertising was new there existed no newspaper directories. To advertise in a given territory it was necessary to go to an advertising agent who had lists of the newspapers and knew their rates. Agents often purchased several columns of space in a number of newspapers by the year, re-selling allotments to advertisers for a price less than the newspaper would charge direct. The advertising agent was thus a broker, and to encourage him in developing advertising the newspapers paid him a commission on what he sent in. Then, as demand grew, he became also an adviser to new advertisers, giving counsel as to the ways in which a given appropriation should be spent, preparing the text and illustrations and supplementary matter to be used, checking insertions in papers and bills, etc. This detail work is complex, and the advertising agent usually performs it more reasonably than an advertiser could do himself. From a broker in space, the advertising agent of the present day has become a specialist whose services are valued because he has a wide experience in directing the operations of many advertisers, as well as an equipment for writing and illustrating advertising matter. While the advertising agent is still

paid by commissions of 10 to 15 per cent allowed him by publishers of newspapers and magazines, he is in no sense the agent of the publishers, but receives rather a wholesale rate upon advertising space, which he sells to the advertiser at a retail or gross price. An advertising agent's interests are so wholly bound up with his advertising client's that in some instances he receives for his services a salary besides. Advertising agents have been of the utmost importance in the development of advertising, for by active work in leading conservative business houses to utilize this modern distributive force, they have built up the revenues of publishers, improved publications and driven advertising charlatans from the field. A few of the largest advertisers maintain departments in their business to prepare and supervise their own advertising, while publishers of magazines and newspapers also carry on independently the work of converting business houses to advertising. Despite this, the agent's function has remained an indispensable one, and with the development of advertising he has entrenched it by specializing. One of the leading New York advertising agencies, for example, has been instrumental in building up the large showing of steamship, railroad and travel advertising now carried in leading magazines, with supplementary advertising of hotels and resorts. Two other agencies are known for their work among advertisers of agricultural implements, another has found its field in the development of textile advertising through magazine and trade journal advertising, etc.

With the past decade the advertising agent has ceased to be what the name would imply and has really become a professional man whose advice is sought as such by the largest commercial and financial concerns. The leaders in this new profession have become experts on trade conditions, and in the introduction of new goods or the development of trade in well-established lines. The modern well-equipped advertising agency has attached to it not only competent writers of advertisments, artists and photographers, but experts in salesmanship who study economic questions and conditions with the greatest thoroughness. This branch of the work has been carried by some of the leading agencies to the point of becoming advisors and lecturers to the regularly employed traveling men of the concerns represented.

Special Advertising Agencies differ from the foregoing *general* advertising agencies in that they actually represent the publishers of certain newspapers or miscellaneous journals in a given territory, promoting advertising only for those journals and receiving commissions on all business that comes from such territory. These special agents are found chiefly in New York and Chicago, where a large percentage of advertising originates, and are simply branch offices of publishers outside such cities, who take such means for being represented. In several States associations have been formed among the smaller daily papers who unite in employing a representative who acts as their agent in procuring business.

As advertising has developed in this country it seeks ever new, varied channels, so that while it is possible by a proper selection of mediums to reach practically the whole public, it is also possible, on the other hand, to appeal to a small group of persons interested in some special commodity. No adequate outline of the many forms of advertising could be given in an article of this scope, and readers interested in a fuller presentation of methods, cost, the stories of famous advertisers, etc., are referred to 'History of Advertising' (London, 1874); 'Modern Advertising' (New York, 1905); 'The Theory of Advertising' (Boston, 1904); 'Forty Years an Advertising Agent' (New York, 1906); 'Principles of the Mail Order Business' (Chicago, 1903); 'The Business of Advertising' (London, 1905). In addition to the above there are numerous newspaper directories published annually.

American advertising has a large periodical literature of its own, comprising fully 25 weekly and monthly journals. Many of these are illustrated and assume the dignity in matter and typography of the standard magazine. Among the most notable of these publications are 'Printers' Ink' (weekly, New York); 'Profitable Advertising' (monthly, Boston); 'Fame' (monthly, New York); 'Agricultural Advertising' (monthly, Chicago); 'Mail Order Journal' (monthly, Chicago); 'Judicious Advertising' (monthly, Chicago); 'Ad Sense' (monthly, Chicago), and others. FRANK PRESBREY.

The Frank Presbrey Co., New York.

Advocate, (1) Originally one whose aid was called in or invoked; one who helped in any business matter; (2) in law, at first, one who gave his legal aid in a case, without, however, pleading, this being the function of the *patronus;* (3) the *advocatus fisci,* who attended to the interests of the *fiscus,* or the emperor's privy purse.

In the old German empire, a person appointed by the emperor to do justice. In Germany and elsewhere juridical advocates were made judges in consequence of their attending when causes were pleaded in the count's court.

In the mediæval church, one appointed to defend the rights and revenues of a church or monastery. The word advocate, in the sense of a defender of the Church, was ultimately superseded by that of patron, but it still lingers in the term advowson.

Constitutional advocates, in Rome, pleaded before the consistory in cases relating to the disposal of benefices which they opposed. Elective advocates were chosen by a bishop, an abbot, or a chapter. Feudal advocates were persons assigned lands on condition of their fighting for the Church, leading out their vassals for the purpose. Matricular advocates defended the cathedral churches. Military advocates were appointed to fight for the Church. The Devil's advocate is a Roman ecclesiastic whose office it is to urge whatever objections may exist to the canonization of any proposed saint.

In English law, originally one who pleaded a cause in a civil, but not in a criminal, court; alone entitled to plead as counsel in ecclesiastical and admiralty courts, which are now thrown open to the ordinary bar. Now, in English and American law, one who pleads a cause in any court. It is not properly speaking, a technical word, but is used only in a popular sense, while the attorney and barrister (q.v.) have defined special attributes.

Æe'tes. See ARGONAUTS.

Æga'dian Islands, a group lying off the W. extremity of Sicily, and consisting of Maritimo, Favignana, Levanso, and Le Formiche. Favignana, the largest, is about 14 m. in circuit, and has productive tunny and anchovy fisheries. The group has a population of 6,300. Near these islands the Romans won a great naval battle with the Carthaginians, 741 B.C., which ended the first Punic war.

Ægean Sea, ē-jē'an or ī'gā-an, the old name of the gulf between Asia Minor and Greece, now usually called the Grecian Archipelago (q.v.).

Ægeus, ē'jūs. See THESEUS.

Ægi'na, a Greek island about 15 m. S.W. of Athens, in the Gulf of Ægina (old Sinus Saronicus); area, 32 sq. m.; pop. about 7,000. It is the triangular top of a partly submerged rocky hill, with deep gorges and ravines, and the eastern half rocky and unproductive; but the western is a well-cultivated plain, which under the warm air and sea produce the best Greek almonds, with olives and other fruits, wine, and some grain. The non-agricultural inhabitants do a considerable commerce and navigation from the one port, the capital, Ægina (pop. about 5,000), at the northwest, on the site of the old Greek town, of which considerable remains are left, the ruins of solidly built walls and harbor moles still attesting its ancient size and importance. According to the legend, the island was named after the nymph Ægina, brought thither by Zeus. Historically, its first inhabitants were Achæans, and were expelled by a Dorian colony from Epidaurus, under whom it was one of the foremost commercial cities of Greece, full of hardy, energetic people, born seamen, who covered themselves with glory at Salamis. They were later forced to become a tributary part of the Athenian empire, and in 431 B.C. were expelled altogether. Lysander afterward restored them, but the city's old importance was gone. On a hill in the northeast are the remains of a splendid temple of Zeus Panhellenius (or, as others maintain, of Athena), many of the columns of which are still standing. Here were found in the early 19th century a number of marble statues which once adorned the east and west fronts of the temple; they were purchased by the king of Bavaria in 1812, the deficient parts restored by Thorwaldsen, and are now among the chief ornaments of the Glyptothek at Munich.

Æg'inhard. See EGINHARD.

Ægir, ā'jir, a Norse god of the sea-storms, who treats the other gods to foaming beer, and has a wife Ran caring for those lost at sea. Their nine daughters are sea-waves, with names representing the aspects of the ocean.

Ægirite, a mineral essentially identical with acmite (q.v.). Like it, ægirite is monoclinic, and is a silicate of sodium and both ferric and ferrous iron, the former largely predominating. It is a member of the pyroxene group and is regarded by Miers as an alkali diopside. It is distinguished from acmite by its simple, prismatic crystals, usually bluntly terminated, its dark green color, and its characteristic grass green, pale green and brown pleochroism. Its hardness is 6 to 6.5 and specific gravity about 3.53. It occurs in long prismatic crystals chiefly in the elæolite-syenites of Norway and Arkansas.

Ægis, e'jis ("storm"), the shield of Zeus, fashioned by Hephæstus (Vulcan). From a probably mistaken etymology it was often said to have been the skin of the goat Amalthea, who suckled Zeus, and to have had the Gorgon's head in the centre. When Zeus was angry he waved and shook the ægis, making a sound like a tempest, by which the nations were overawed. It was the symbol of divine protection, and became in course of time the exclusive attribute of Zeus and Athene.

Ægis'thus, ē-jis'thŭs, son of Thyestes, and cousin of Agamemnon; adopted son of Atreus (q.v.). He did not accompany the Greeks to Troy, and during Agamemnon's absence lived in adultery with his wife Clytemnestra. He assisted her in murdering her husband on his return, but was himself put to death seven years later by Orestes, son of Agamemnon. This is the account given by Homer; the tragic poets make Clytemnestra alone murder Agamemnon, her motive in Æschylus being her jealousy and wrath at the death of Iphigenia of Cassandra; in Sophocles and Euripides, the latter alone. Later writers also describe Ægisthus as the son of Thyestes by unwitting incest with his daughter Pelopia. See AGAMEMNON; ATREUS.

Ægium, ē'jĭ-um, Greece, modern VASTITZA, though officially restored to its ancient name. See ACHAIA.

Ægle, a genus of plants of the natural order *Aurantiaceæ*. The *Ægle marmelos* is the tree which produces the bhel fruit. This fruit is most delicious to the taste, being exquisitely fragrant and nutritious, but laxative. When a little unripe it has been long used in India with great effect as an astringent in cases of diarrhœa and dysentery.

Ægospot'amos or **Ægospot'amoi** ("goat-river"), the Thracian Chersonesus (now peninsula of Gallipoli): a river and town memorable for the battle, or rather surprise, in which the Spartan general Lysander annihilated the Athenian fleet, 13 Dec. B.C. 405, and ended the Peloponnesian war by the temporary ruin of Athens. The latter had 180 vessels, with a number of coequal commanders, only one of whom (Conon) had common military sense, and perhaps treachery was at work; while Lysander was an eminent military genius and had no one to consult but himself. Having put them off their guard by ostentatious carelessness and absence for several days, he swooped down upon them one day at dinner-time while their ships were totally unprepared (despite the warnings of Alcibiades, whose castle was close by and who was fully a match for Lysander), and destroyed or captured the entire fleet except Conon's small squadron. Athens fell under the rule of Sparta, which set up an aristocratic government, the outcome of which is infamous in history as the Thirty Tyrants.

Ægyp'tus, in Greek legend, son of Belus, king of Arabia; conquered the land called Egypt from him. He gave his fifty sons in marriage to the fifty daughters of his brother Danaus, who had established himself in Argos and was jealous of his brother, and who obliged all his daughters to murder their husbands on the night

of their nuptials: Hypermnestra alone spared her husband, Lynceus. Even Ægyptus was killed by his niece Polyxena. See DANAUS; EGYPT.

Ælfric, āl'fric, the **Grammarian**, Anglo-Saxon author and translator; fl. 1006. In his youth he was taught by a secular priest who could scarcely understand Latin. "There was no one," he says, "who could write or understand Latin letters until Dunstan and Æthelwold revived learning." This may account for his warm interest in education and his industry in translation and compilation. 'A Treatise on the Old and New Testaments' (printed 1623); the 'Heptateuchus,' an abridgment and translation of the first seven books of the Old Testament, with the Book of Job (pr. 1699); a 'Pastoral Letter,' written for Wulfstan, archbishop of York (1003-23), in which he makes the archbishop declare that he will not forcibly compel his clergy to chastity, but admonishes them to observe it; a 'Latin Grammar and Glossary' (printed by Somner, 1659).

Ælia, a Roman *gens*, whose members included Sejanus, Hadrian, and the Antonines, as also the families of Pætus (q.v.), Gallus, etc.

Ælia Capitolina, the new name given to Jerusalem by Hadrian when he colonized it with Romans after the insurrection of 132-5 A.D.; he built a temple to Jupiter Capitolinus, and prefixed the name of his own *gens*, the Ælian. The Christian emperors after Constantine restored the old name.

Ælianus, Claudius, ē-li-ā'nus, a noted Roman sophist who flourished in the first half of the 2d century: b. Præneste, Italy. Of his many works, written in Greek, two are extant: 'Various Histories,' or narratives, in 14 books, and 'Of the Nature of Animals,' anecdotes of animals,— most entertaining and uncritical compilations. The 'Peasants' Letters' accredited to him are spurious. Best ed., Hercher, 1858 and 1864.

Æmilia'nus, C. Julius, emperor of Rome: a Moor who rose from the lowest stations; governor of Pannonia and Mœsia, whose troops killed the Emperor Gallus and gave him the crown. He reigned only four months, when he was killed in his 46th year by his own soldiers, who then offered the crown to Valerian.

Æmilian Way, a Roman state road about 185 m. long, built by the consul Marcus Æmilius Lepidus, 187 B.C., primarily as a military road to make easy communication between Rome and her new possessions in Cisalpine Gaul (Lombardy). Beginning at Ariminum (Rimini) on the Adriatic, where the Flaminian way from Rome ended, it traversed Bononia (Bologna), Mutina (Modena), and Parma, crossed the Padus (Po) at Placentia (Piacenza), and ended at Mediolanum (Milan).

Æmil'ius Paulus, surnamed *Macedonicus*, a noble Roman of the ancient family of Æmilii: b. 230 B.C.; d. 160. He conquered Perseus, king of Macedon, and on this occasion obtained a triumph, 168 B.C. During the triumph two of his sons died. He bore the loss like a hero, and thanked the gods that they had chosen them for victims to avert bad fortune from the Roman people. He was father of the renowned Scipio Africanus the Younger.

Æne'as, in the Iliad, a Trojan prince, son of Anchises and the goddess Venus; second only to his kinsman Hector among the Trojan chiefs. Other stories tell that the care of his infancy was entrusted to a nymph; but at the age of five he was recalled to Troy and placed under the inspection of Alcathoüs, his father's friend and companion. He afterward improved himself in Thessaly under Chiron the Centaur, whose house was frequented by all the young princes and heroes of the age. Soon after his return home he married Creusa, Priam's daughter, by whom he had a son called Ascanius. Vergil, whose object is to connect him (according to Latin tradition of untraceable source) with the origin of Rome, tells his further story as follows in the Æneid. In the night of the capture of Troy by the Greeks, Hector warned him in a dream to fly. Æneas notwithstanding rushed to the fight; but after Priam was slain returned to his home and carried off his father, his child, and his household gods, losing, however, his wife, Creusa, in the confusion. With twenty vessels he sailed for Thrace, where he began to build Ænos, but terrified by a miracle abandoned the attempt. Thence he went to Delos to consult the oracle. Misunderstanding its reply he went to Crete, from which he was driven by a pestilence; thence to the promontory of Actium, and in Epirus found Helenus and Andromache; thence past Italy and through the Straits of Messina, and circumnavigated Sicily to Cape Drepanum on the western coast, where Anchises died. A tempest drove him on the shore of Africa, where Dido received him kindly in Carthage and wished to detain and marry him. Jupiter, however, mindful of the Fates, sent Mercury to Æneas and commanded him to sail for Italy. While the deserted Dido ended her life on the funeral pile, Æneas set sail with his companions and was cast by a storm on the shores of Sicily, in the dominions of his Trojan friend Acestes, where the wives of his companions, wearied of a seafaring and homeless life, set fire to the ships. Nevertheless, after building the city Acesta, he sailed for Italy, leaving the women and the sick behind. He found near Cumæ a sibyl his father's ghost had ordered him to seek, who foretold his destiny and aided his descent into the lower world: here he saw his father and had a prophetic vision of the glorious destinies of his race. On his return he embarked again and reached the eastern shore of the river Tiber, in the country of Latinus, king of the Aborigines (q.v.). His daughter Lavinia was destined by an oracle to a stranger, but promised by her mother Amata to Turnus, king of the Rutuli. This occasioned a war, after the termination of which, Turnus having fallen by his hand, Æneas married Lavinia. His son by Lavinia, Æneas Sylvius, was the ancestor of the kings of Alba Longa, and of Romulus and Remus, the founders of the city of Rome. From Ascanius' son Iulus the Romans derive the Julian family. For the real origin of Rome, see that title.

Æneas Silvius. See PIUS II.

Æne'id, one of the great epic poems of the world; written in Latin by Vergil and published after his death, which took place about 16 B.C. Being left imperfect, his friends Varius and Tucca edited it at Augustus' request. For its story, see ÆNEAS. See also VERGIL.

Æneside'mus, Greek philosopher, fl. 80–60 B.C.: b. Cnossus in Crete, removed to Alexandria. He was a leader of the Skeptical school, and is famous for the "Ten Tropes" attributed to him,— arguments to prove the impossibility of absolute knowledge, and reducible in essence to two, that no two things are alike and everything is relative. They are: (1) That each sentient being must have a different perception and conception of the universe from every other because differently constituted; (2) that human beings differ; (3) that sense organs differ; (4) that the circumstances of perceptions differ; (5) that objects perceived differ in location and distance; (6) that different objects are confounded; (7) that different combinations make the same sensation seem different; (8) that all knowledge is relative; (9) that degrees of familiarity cause differences in perception; (10) that the intellectual speculations, moral theories, laws, manners and customs, civilizations, etc., of all races differ (Locke's argument against intuitive ideas).

Ænianes, ē-nī'a-nēs, in classic Greek, an Achæan people living on the southern border of Thessaly, in the mountains west of Thermopylæ; members of the Ætolian League and the Delphic Amphictyony.

Æo'lian, a musical instrument. See MUSICAL INSTRUMENTS, MECHANICAL.

Æolian Harp, or **Æolus' Harp,** is generally a simple box of thin fibrous wood to which are attached a number of fine strings, sometimes as many as fifteen, stretched on low bridges at each end, and carefully tuned so as to be in harmony. Its length is made to correspond to the size of the window or other aperture in which it is intended to be placed. Its width is about five or six inches, its depth two or three. It must be placed with the strings uppermost, under which is a circular opening in the centre, as in the belly of the guitar. When the wind blows athwart the strings it produces the effect of a choir of music in the air, sweetly mingling all the harmonic notes, and swelling or diminishing the sounds according to the strength or weakness of the blast. A simpler kind of Æolian harp has no sounding-board, but consists merely of a number of strings extended between two boards.

Æolians ("variegated," mixed race), an ancient Greek people, perhaps the very earliest Greek stock — a mixture of Hellenes and Pelasgi — before the special races like Ionians and Dorians had differentiated from it; as their language was not a distinct dialect like those, but is a mixture of elements from all and presents the closest link of any between Greek and Latin. The Homeric language is Æolic. The race extended from northeast to southwest through Greece, from the Pagasaic Gulf through Thessaly or at least Phthiotis, Bœotia, Phocis, Locris, and Ætolia north of the Corinthian Gulf, to Elis and Messenia south of it. The sons of Æsculapius (q.v.), Philoctetes, Odysseus, Nestor, and the Oïlean Ajax, were Æolians; and legend accredits to the same stock Jason, Melampus the healer who understood the song of birds, Sisyphus the founder of Corinth, and Athamas the great king of the Minyæ, son-in-law of Cadmus and father of Phrixus and Helle. The Achæans, if not originally part of the same stock, became blent with them and are classed by the ancients as part of them; and there is no separate Achæan dialect or art. Probably they were one, and the Peloponnesian Achæi were certainly part of them; and the great emigration commonly called the Æolian was an emigration of Achæan people. It seems probable that the emigration from the Peloponnesus began before the Dorian invasion, or return of the Heraclidæ, as it is often called, which caused so great a revolution in the peninsula. Strabo says the Æolian settlements in Asia were four generations prior to the Ionian. Their colonies on the Asiatic mainland were widely spread, extending at least from Cyzicus, along the shores of the Hellespont and the Ægean, to the river Caicus, and even the Hermus. Many positions in the interior were also occupied by them, as well as the fine island of Lesbos, with Tenedos, and others of smaller importance. Homer mentions all these parts as possessed by a different people; which would be proof, if any were wanting, that the race of new settlers came after his time. There were twelve cities or states included in the older settlments in that tract of Asia Minor on the Ægean which was known in Greek geography by the name of Æolis and formed a part of the subsequent larger division of Mysia. Smyrna, one of them, which early fell into the hands of the Ionians, the neighbors of the Æolians, still exists nearly on the old spot, with exactly the same name; thus adding one to the many instances of the durable impression made by Greek colonies wherever they settled.

Æolis. See ÆOLIANS.

Æ'olus, in Greek legend: (1) Ruler of the winds; a sort of sub-deity, having his residence in a floating island, said to be one of the Æolian Islands, or by the Latin and later Greek poets one of the Lipari Islands. Here he kept the winds in bags (Virgil says in caves), restraining or letting them loose at the orders of Zeus. In the Odyssey he gives them to Odysseus to take care of for a time. (2) The eponymous ancestor of the Æolians, located in Thessaly; Hellen was his father and Dorus his brother (eponyms of the Hellenes and Dorians), and Sisyphus his son, the significance of which is not ascertainable. (1) and (2) may have been originally the same, but if so they arose as independent metaphors or eponyms.

Æqui, an ancient people of Italy, conspicuous in the early wars of Rome. They inhabited the mountain district between the upper valley of the Anio (Teverone) and Lake Fucinus. Their origin is unknown; but they were probably akin to the Volscians, with whom they were in constant alliance. This league after the fall of the monarchy made great headway and captured many towns, their power culminating in the 5th century B.C. At length they were severely defeated by Cincinnatus in 458, and again by the dictator Postumus Tubertus in 428. They were finally subdued about 304, and soon after were admitted to Roman citizenship, being included in the new tribes Aniensis and Terentina. Henceforth their name disappears from history; but the inhabitants of the upper valleys began to be called Æquiculi, by which name they are mentioned by Vergil as predatory mountaineers. The name Æquiculani occurs in Pliny.

Ærarium, e-rā'ri-um ("money-place"), the public treasury of ancient Rome; containing not only the state moneys and accounts, but the legionary standards, the public laws (on brass plates), senate decrees, and other important papers and registers. It was located in the temple of Saturn, on the eastern slope of the Capitoline hill. Besides the general treasury, filled from general taxes and drawn on for regular expenses, there was in the same building, a "sacred treasury," or reserve fund, replenished chiefly by a 5 per cent tax on the value of manumitted slaves, which was never drawn upon except on occasions of extreme necessity. The senate controlled the ærarium nominally even under the early emperors, who had their separate imperial treasury called the *fiscus;* but as the senate became a mere name, the figment of two treasuries was gradually abolished. Augustus established also a military treasury devoted solely to army accounts. The later emperors had likewise a private treasury, aside from the general one which they administered for the empire.

Aërated Bread. See BREAD.

Aërated Waters. See MINERAL WATERS.

Aërial Conveyer. See CONVEYER.

Aërial Locomotion. We are all of us interested in aërial locomotion; and I am sure that no one who has observed with attention the flight of birds can doubt for one moment the possibility of aërial flight by bodies specifically heavier than the air. In the words of an old writer, "We cannot consider as impossible that which has already been accomplished."

I have had the feeling that a properly constructed flying-machine should be capable of being flown as a kite; and, conversely, that a properly constructed kite should be capable of use as a flying-machine when driven by its own propellers. I am not so sure, however, of the truth of the former proposition as I am of the latter. Given a kite, so shaped as to be suitable for the body of a flying-machine, and so efficient that it will fly well in a good breeze (say 20 miles an hour) when loaded with a weight equivalent to that of a man and engine; then it seems to me that this same kite, provided with an actual engine and man in place of the load, and driven by its own propellers at the rate of 20 miles an hour, should be sustained in calm air as a flying-machine. So far as the pressure of the air is concerned, it is surely immaterial whether the air moves against the kite, or the kite against the air.

Of course in other respects the two cases are not identical. A kite sustained by a 20-mile breeze possesses no momentum, or rather its momentum is equal to zero, because it is stationary in the air and has no motion proper of its own; but the momentum of a heavy body propelled at 20 miles an hour through still air is very considerable. Momentum certainly aids flight, and it may even be a source of support against gravity quite independently of the pressure of the air. It is perfectly possible, therefore, that an apparatus may prove to be efficient as a flying-machine which cannot be flown as a kite on account of the absence of *vis viva*. However this may be, the applicability of kite experiments to the flying-machine problem has for a long time past been the guiding thought in my researches.

I have not cared to ascertain how high a kite may be flown or to make one fly at any very great altitude. The point I have had specially in mind is this: That the equilibrium of the structure in the air should be perfect; that the kite should fly steadily, and not move about from side to side or dive suddenly when struck by a squall, and that when released it should drop slowly and gently to the ground without material oscillation. I have also considered it important that the framework should possess great strength with little weight.

I believe that in the form of structure now attained the properties of strength, lightness, and steady flight have been united in a remarkable degree. In my younger days the word "kite" suggested a structure of wood in the form of a cross covered with paper forming a diamond-shaped surface longer one way than the other, and provided with a long tail composed of a string with numerous pieces of paper tied at intervals upon it. Such a kite is simply a toy. In Europe and America, where kites of this type prevailed, kite-flying was pursued only as an amusement for children, and the improvement of the form of structure was hardly considered a suitable subject of thought for a scientific man. In Asia kite-flying has been for centuries the amusement of adults, and the Chinese, Japanese, and Malays have developed tailless kites very much superior to any form of kite known to us until quite recently. It is only within the last few years that improvements in kite structure have been seriously considered, and the recent developments in the art have been largely due to the efforts of one man — Laurence Hargrave of Australia.

Hargrave realized that the structure best adapted for what is called a "good kite" would also be suitable as the basis for the structure of a flying-machine. His researches, published by the Royal Society of New South Wales, have attracted the attention of the world, and form the starting point for modern researches upon the subject in Europe and America. Anything relating to aërial locomotion has an interest to very many minds, and scientific kite-flying has everywhere been stimulated by Hargrave's experiments.

In America, however, the chief stimulus to scientific kite-flying has been the fact developed by the United States Weather Bureau, that important information could be obtained concerning weather conditions if kites could be constructed capable of lifting meteorological instruments to a great elevation in the free air. Mr. Eddy and others in America have taken the Malay tailless kite as a basis for their experiments, but Prof. Marvin, of the United States Weather Bureau; Mr. Rotch, of the Blue Hill Observatory, and many others have adapted Hargrave's box kite for the purpose. Congress has made appropriations to the Weather Bureau in aid of its kite experiments, and a number of meteorological stations throughout the United States were established a few years ago equipped with the Marvin kite. Continuous meteorological observations at a great elevation have been made at the Blue Hill Observatory in Massachusetts, and Mr. Rotch has demonstrated the possi-

bility of towing kites at sea by means of steam vessels so as to secure a continuous line of observations all the way across the Atlantic.

HARGRAVE'S BOX KITE.

Hargrave introduced what is known as the "cellular construction of kites." He constructed kites composed of many cells, but found no substantial improvement in many cells over two alone; and a kite composed of two rectangular

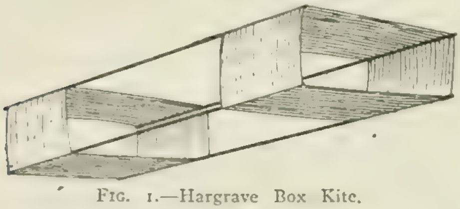


FIG. 1.—Hargrave Box Kite.

cells separated by a considerable space is now universally known as "the Hargrave box kite." This represents, in my opinion, the high-water mark of progress in the 19th century; and this form of kite forms the starting point for my own researches (Fig. 1). The front and rear cells are connected by a framework, so that a considerable space is left between them. This space is an essential feature of the kite: upon it depends the fore and aft stability of the kite. The greater the space, the more stable is the equilibrium of the kite in a fore and aft direction, the more it tends to assume a horizontal position in the air, and the less it tends to dive or pitch like a vessel in a rough sea. Pitching motions or oscillations are almost entirely suppressed when the space between the cells is large. Each cell is provided with vertical sides; and these again seem to be essential elements of the kite contributing to lateral stability. The greater the extent of the vertical sides, the greater is the stability in the lateral direction, and the less tendency has the kite to roll, or move from side to side, or turn over in the air.

In the foregoing drawing I have shown only necessary details of construction, with just sufficient framework to hold the cells together. It is obvious that a kite constructed as shown in Fig. 1 is a very flimsy affair. It requires additions to the framework of various sorts to give it sufficient strength to hold the aëroplane surfaces in their proper relative positions and prevent distortion, or bending or twisting of the kite frame under the action of the wind. Unfortunately the additions required to give rigidity to the framework all detract from the efficiency of the kite: First, by rendering the kite heavier, so that the ratio of weight to surface is increased; and secondly, by increasing the head resistance of the kite. The interior bracing advisable in order to preserve the cells from distortion comes in the way of the wind, thus adding to the ***drift*** of the kite without contributing to the ***lift***.

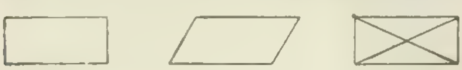


FIG. 2.

A rectangular cell like *A* (Fig. 2) is structurally weak, as can readily be demonstrated by the little force required to distort it into the form shown at *B*. In order to remedy this weakness, internal bracing is advisable of the character shown at *C*. This internal bracing, even if made of the finest wire, so as to be insignificant in weight, all comes in the way of the wind, increasing the head resistance without counterbalancing advantages.

Triangular Cells in Kite Construction.—In looking back over the line of experiments in my own laboratory, I recognize that the adoption of a triangular cell was a step in advance, constituting indeed one of the milestones of progress, one of the points that stand out clearly against the hazy background of multitudinous details. The following (Fig. 3) is a drawing of a typical triangular-celled kite made upon the same general model as the Hargrave box kite shown in Fig. 1. A triangle is by its very structure perfectly braced in its own plane, and in a triangular-celled kite like that shown in Fig. 3, internal bracing of any character is unnecessary

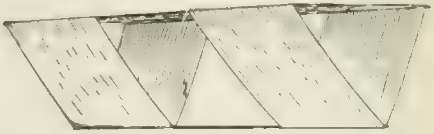


FIG. 3.

to prevent distortion of a kind analogous to that referred to above in the case of the Hargrave rectangular cell (Fig. 2).

The lifting power of such a triangular cell is probably less than that of a rectangular cell, but the enormous gain in structural strength, together with the reduction of head resistance and weight due to the omission of internal bracing, counterbalances any possible deficiency in this respect.

The horizontal surfaces of a kite are those that resist descent under the influence of gravity, and the vertical surfaces prevent it from turning over in the air. Oblique aëroplanes may therefore conveniently be resolved into horizontal and vertical equivalents, that is, into supporting surfaces and steadying surfaces. The oblique aëroplane *A*, for example (Fig. 4), may be considered as equivalent in function to the two aëroplanes *B* and *C*. The material composing the aëroplane *A*, however, weighs less than the material required to form the two aëroplanes

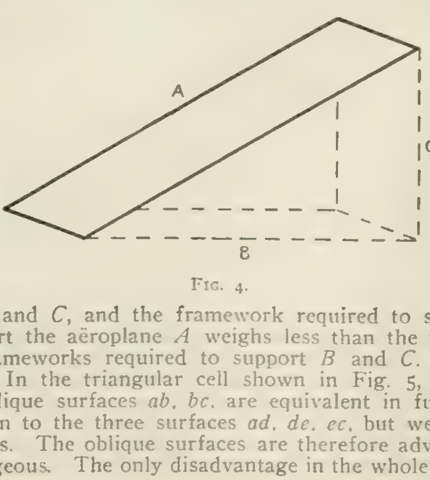


FIG. 4.

B and *C*, and the framework required to support the aëroplane *A* weighs less than the two frameworks required to support *B* and *C*.

In the triangular cell shown in Fig. 5, the oblique surfaces *ab*, *bc*, are equivalent in function to the three surfaces *ad*, *de*, *ec*, but weigh less. The oblique surfaces are therefore advantageous. The only disadvantage in the whole ar

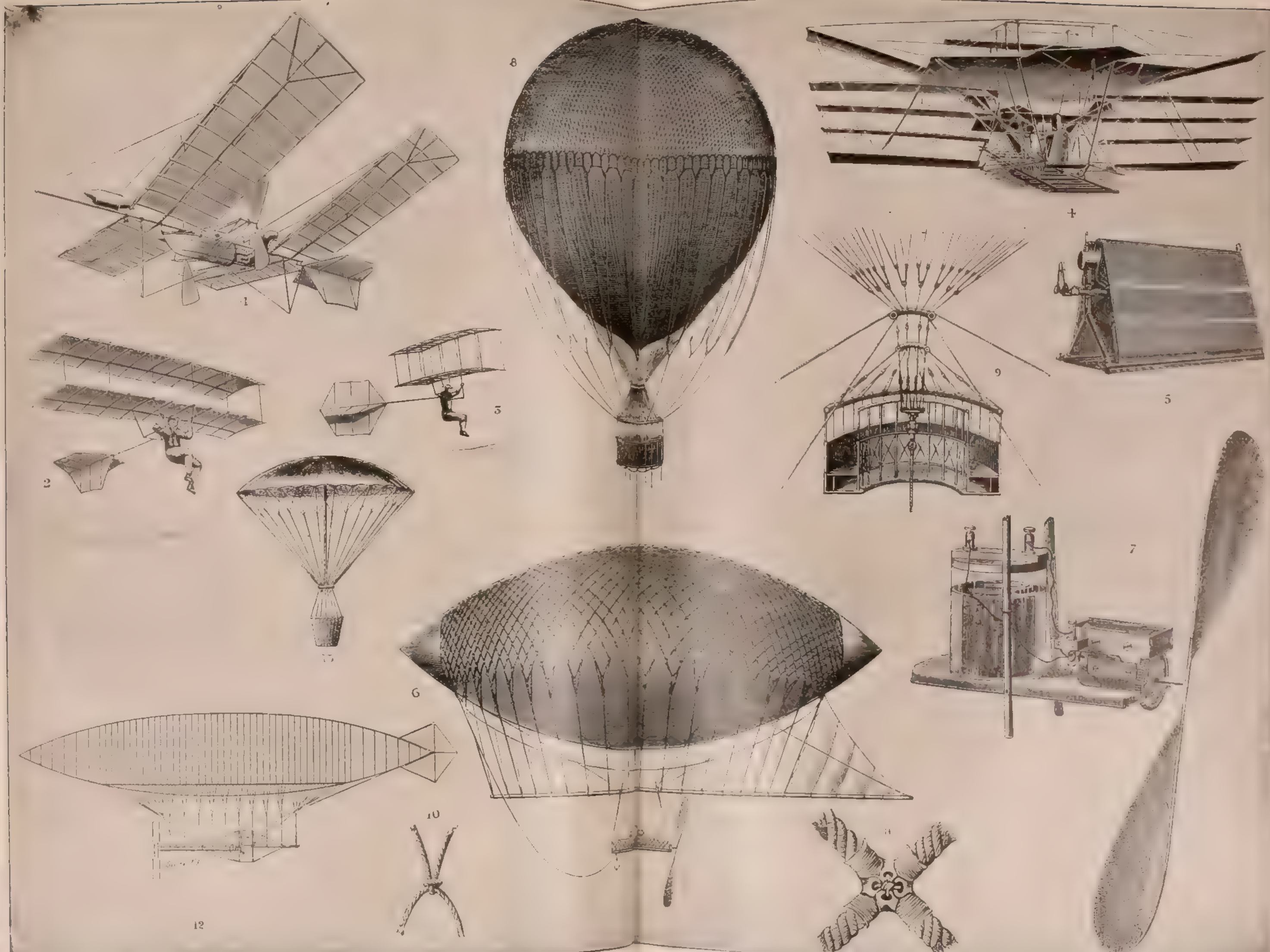


Fig. 1 Langley's Flying Machine. 2 Chanute's Gliding Machine—off. 3 Chanute's Gliding Machine—stepping [illegible] 4 The [illegible] Flying Machine. 5 The Boiler of the Maxim Machine. 6 Balloon with Electric Motor. 7 Propeller of same, with Motor and gearing enlarged. 8 Great Captive Balloon used at Paris. 9 Section of Car of same. 10, 11 Knot of ordinary [illegible] as compared with that adopted in Netting of Captive Balloon. 12 Outline Diagram of the Santos-Dumont Air Ship. 13 Parachute [illegible] when descending.

rangement is that the air has not as free access to the upper aëroplane *ac*, in the triangular form of cell as in the quadrangular form, so that the aëroplane *ac* is not as efficient in the former construction as in the latter.

While theoretically the triangular cell is inferior in lifting power to Hargrave's four-sided

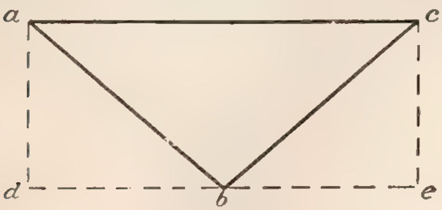


Fig. 5.

rectangular cell, practically there is no substantial difference. So far as I can judge from observation in the field, kites constructed on the same general model as the Hargrave box kite, but with triangular cells instead of quadrangular, seem to fly as well as the ordinary Hargrave form, and at as high an angle. Such kites are therefore superior, for they fly substantially as well, while at the same time they are stronger in construction, lighter in weight, and offer less head resistance to the wind.

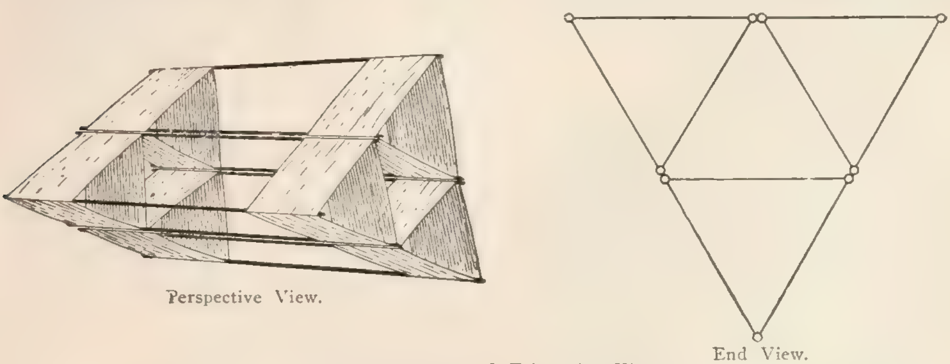


Fig. 6.—Compound Triangular Kite.

Triangular cells also are admirably adapted for combination into a compound structure, in which the aëroplane surfaces do not interfere with one another. For example, three triangular-celled kites, tied together at the corners, form a compound cellular kite (Fig. 6) which flies perfectly well. The weight of the compound kite is the sum of the weights of the three kites of which it is composed, and the total aëroplane surface is the sum of the surfaces of the three kites. The ration of weight to surface therefore is the same in the larger compound kite as in the smaller constituent kites, considered individually.

It is obvious that in compound kites of this character the doubling of the longitudinal sticks where the corners of adjoining kites come together is an unnecessary feature of the combination, for it is easy to construct the compound kite so that one longitudinal stick shall be substituted for the duplicated sticks. For example: The compound kites *A* and *B* (Fig. 7) may be constructed, as shown at *C* and *D*, with advantage, for the weight of the compound kite is thus reduced without loss of structural strength. In this case the weight of the compound kite is less than the sum of the weights

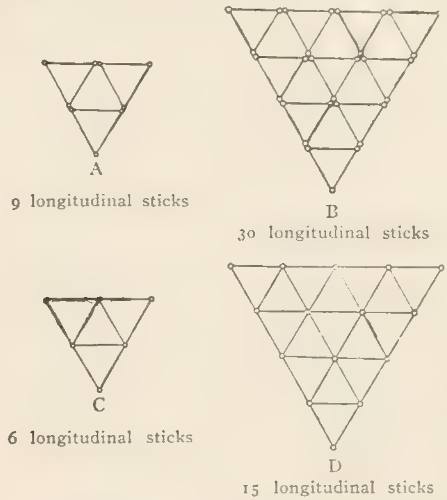


Fig. 7.

of the component kites, while the surface remains the same. If kites could only be successfully compounded in this way indefinitely we would have the curious result that the ratio of weight to surface would diminish with each increase in the size of the compound kite. Unfortunately, however, the conditions of stable flight demand

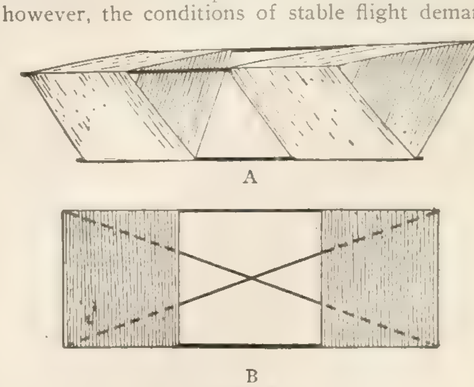


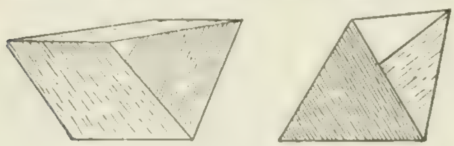
Fig. 8.

a considerable space between the front and rear sets of cells (see Fig. 6); and if we increase the diameter of our compound structure with-

out increasing the length of this space we injure the flying qualities of our kite. But every increase of this space in the fore and aft direction involves a corresponding increase in the length of the empty framework required to span it, thus adding dead load to the kite and increasing the ratio of weight to surface. While kites with triangular cells are strong in a transverse direction (from side to side), they are structurally weak in the longitudinal direction (fore and aft), for in this direction the kite frames are rectangular. Each side of the kite *A*, for example (Fig. 8), requires diagonal bracing of the character shown at *B* to prevent distortion under the action of the wind. The necessary bracing, however, not being in the way of the wind, does not materially affect the head resistance of the kite, and is only disadvantageous by adding dead load, thus increasing the ratio of weight to surface.

THE TETRAHEDRAL CONSTRUCTION OF KITES.

Passing over in silence multitudinous experiments in kite construction carried on in my Nova Scotia laboratory, I come to another con-

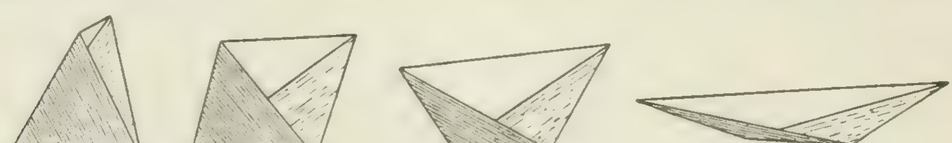


A B

FIG. 9.

A.—A Triangular Cell.
B.—A Winged Tetrahedral Cell.

spicuous point of advance — another milestone of progress — the adoption of the triangular construction *in every direction* (longitudinally as well as transversely); and the clear realization of the fundamental importance of the skeleton of a tetrahedron, especially the regular tetrahedron, as an element of the structure of framework of a kite or flying-machine.



Acute-angled tetrahedron — Regular tetrahedron — Right-angled tetrahedron — Obtuse-angled tetrahedron

FIG. 10.—Winged Tetrahedral Cells.

Consider the case of an ordinary triangular cell *A* (Fig. 9) whose cross-section is triangular laterally, but quadrangular longitudinally. If now we make the longitudinal as well as transverse cross-sections triangular, we arrive at the

FIG. 11.—One-celled Tetrahedral Frame.

form of cell shown at *B*, in which the framework forms the outline of a tetrahedron. In this case the aëroplanes are triangular, and the whole arrangement is strongly suggestive of a pair of birds' wings raised at an angle and connected tip to tip by a cross-bar (see *B*, Fig. 9; also drawings of winged tetrahedral cells in Fig. 10).

A tetrahedron is a form of solid bounded by four triangular surfaces. In the regular tetrahedron the boundaries consist of four equilateral triangles and six equal edges. In the skeleton form the edges alone are represented, and the skeleton of a regular tetrahedron is produced by joining together six equal rods end to end so as

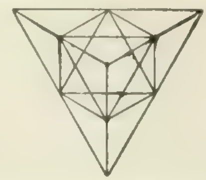


FIG. 12.—Four-celled Tetrahedral Frame.

to form four equilateral triangles. Most of us no doubt are familiar with the common puzzle — how to make four triangles with six matches. Give six matches to a friend and ask him to arrange them so as to form four complete equilateral triangles. The difficulty lies in the unconscious assumption of the experimenter that the four triangles should all be in the same plane. The moment he realizes that they need not be in the same plane the solution of the problem becomes easy. Place three matches on the table so as to form a triangle, and stand the other three up over this like the three legs of a tripod stand. The matches then form the skeleton of a regular tetrahedron. (See Fig. 11.) A framework formed upon this model of six equal rods fastened together at the ends constitutes a tetrahedral cell possessing the qualities of strength and lightness in an extraordinary degree. It is not simply braced in two directions in space like a triangle, but in three directions like a solid. If I may coin a word, it possesses "three-dimensional" strength; not "two-dimensional" strength like a triangle, or "one-dimensional" strength like a rod. It is the skeleton of a solid, not of a surface or a line. It is astonishing how solid such a framework appears even when composed of very light and fragiie material; and compound structures formed by fastening these tetrahedral frames together at the corners so as to form the skeleton of a regular tetrahedron on a larger scale possess equal solidity. Fig. 12 shows a structure composed of four frames like Fig. 11, and Fig. 13 a structure of four frames like Fig. 12.

When a tetrahedral frame is provided with aëro-surfaces of silk or other material suitably arranged, it becomes a tetrahedral kite, or kite having the form of a tetrahedron. The kite shown in Fig. 14 is composed of four winged

cells of the regular tetrahedron variety (see Fig. 10), connected at the corners. Four kites like Fig. 14 are combined in Fig. 15. Upon this mode of construction an empty space of octahedral form is left in the middle of the

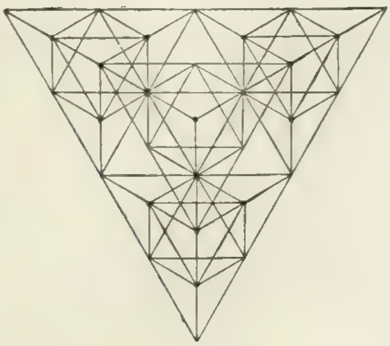


FIG. 13.—Sixteen-celled Tetrahedral Frame.

kite, which seems to have the same function as the space between the two cells of the Hargrave box kite. The tetrahedral kites that have the largest central spaces preserve their equilibrium best in the air.

The most convenient place for the attachment of the flying cord is the extreme point of the bow. If the cord is attached to points successively farther back on the keel, the flying cord makes a greater and greater angle with

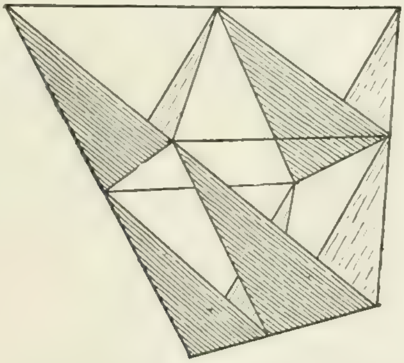


FIG. 14.—Four-celled Tetrahedral Kite.

the horizon, and the kite flies more nearly overhead; but it is not advisable to carry the point of attachment as far back as the middle of the keel. A good place for high flights is a point half way between the bow and the middle of the keel.

In tetrahedral kites the compound structure has itself in each case the form of the regular tetrahedron, and there is no reason why this principle of combination should not be applied indefinitely so as to form still greater combinations.

The weight relatively to the wing-surface remains the same, however large the compound kite may be. The four-celled kite, for example, weighs four times as much as one cell and has four times as much wing-surface, the 16-celled kite has 16 times as much weight and 16 times as much wing-surface, and the 64-celled kite has 64 times as much weight and 64 times as much wing-surface. The ratio of weight to surface therefore is the same for the larger kites as for the smaller.

This at first sight appears to be somewhat inconsistent with certain mathematical conclusions announced by Prof. Simon Newcomb in an article entitled "Is the Air-Ship Coming," published in 'McClure's Magazine' for September 1901 — conclusions which led him to believe that "the construction of an aërial vehicle which could carry even a single man from place to place at pleasure requires the discovery of some new metal or some new force." The process of

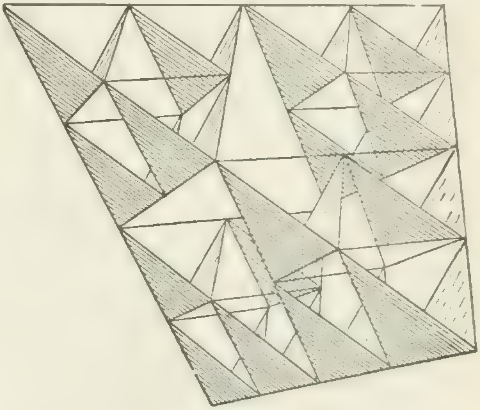


FIG. 15.—Sixteen-celled Tetrahedral Kite.

reasoning by which Prof. Newcomb arrived at this remarkable result is undoubtedly correct. His conclusion, however, is open to question, because he has drawn a general conclusion from restricted premises. He says: "Let us make two flying-machines exactly alike, only make one on double the scale of the other in all its dimensions. We all know that the volume, and therefore the weight, of two similar bodies are proportional to the cubes of their dimensions. The cube of two is eight; hence the large machine will have eight times the weight of the other. But surfaces are as the squares of the dimensions. The square of two is four. The heavier machine will therefore expose only four times the wing surface to the air, and so will have a distinct disadvantage in the ratio of efficiency to weight." Prof. Newcomb shows that where two flying-machines — or kites, for that matter — are exactly alike, only differing in the scale of their dimensions, the ratio of weight to supporting surface is greater in the larger than the smaller, increasing with each increase of dimensions. From which he concludes that if we make our structure large enough it will be too heavy to fly. This is certainly true, so far as it goes, and it accounts for my failure to make a giant kite that should lift a man — upon the model of the Hargrave box kite. When the kite was constructed with two cells, each about the size of a small room, it was found that it would take a hurricane to raise it into the air. The kite proved to be not only incompetent to carry a load equivalent to the weight of a man, but it could not even raise *itself* in an ordinary breeze in which smaller kites upon the same model flew perfectly well. I have no doubt that other investigators also have fallen into the error of sup-

posing that large structures would necessarily be capable of flight, because exact models of them, made upon a smaller scale, have demonstrated their ability to sustain themselves in the air. Prof. Newcomb has certainly conferred a benefit upon investigators by so clearly pointing out the fallacious nature of this assumption.

But Prof. Newcomb's results are probably only true when restricted to his premises. For models exactly alike, only differing in the scale of their dimensions, his conclusions are undoubtedly sound; but where large kites are formed by the multiplication of smaller kites into a cellular structure the results are very different. My own experiments with compound kites composed of triangular cells connected corner to corner have amply demonstrated the fact that the dimensions of such a kite may be increased to a very considerable extent without materially increasing the ratio of weight to supporting surface; and upon the tetrahedral plan the weight relatively to the wing-surface remains the same, however large the compound kite may be.

The indefinite expansion of the triangular construction is limited by the fact that dead weight in the form of empty framework is necessary in the central space between the sets of cells (see Fig. 6), so that the necessary increase of this space when the dimensions of the compound kite are materially increased — in order to preserve the stability of the kite in the air — adds still more dead weight to the larger structures. Upon the tetrahedral plan no necessity exists for empty frameworks in the central spaces, for the mode of construction gives solidity without it. Tetrahedral kites combine in a marked degree the qualities of strength, lightness, and steady flight; but further experiments are required before deciding that this form is the best for a kite, or that winged cells without horizontal aëroplanes constitute the best arrangement of aëro-surfaces. The tetrahedral principle enables us to construct out of light materials solid frameworks of almost any desired form, and the resulting structures are admirably adapted for the support of aëro-surfaces of any desired kind, size, or shape (aëroplanes or aëro-curves, etc., large or small).

In further illustration of the tetrahedral principle as applied to kite construction, I built a kite which is not itself tetrahedral in form, but the framework of which is built up of tetrahedral cells. This kite, although very different in construction and appearance from the Aërodrome of Prof. Langley, which I saw in successful flight over the Potomac a few years ago, has yet a suggestiveness of the Aërodrome about it, and it was indeed Prof. Langley's apparatus that led me to the conception of this form. The wing-surfaces consist of horizontal aëroplanes, with oblique steadying surfaces at the extremities. The body of the machine has the form of a boat, and the superstructure forming the support for the aëroplanes extends across the boat on either side at two points near the bow and stern. The aëroplane surfaces form substantially two pairs of wings, arranged dragon-fly fashion. The whole framework for the boat and wings is formed of tetrahedral cells having the form of the regular tetrahedron, with the exception of the diagonal bracing at the bottom of the superstructure; and the kite turns out to be strong, light, and a steady flyer.

I have flown this kite in a calm by attaching the cord — in this case a Manila rope — to a galloping horse. Upon releasing the rope the kite descended so gently that no damage was done to the apparatus by contact with the ground.

An attempt which almost ended disastrously, was made to fly a modified form of the kite described in a good sailing breeze, but a squall struck it before it was let go. The kite went up, lifting the two men who held it off their feet. Of course they let go instantly, and the kite rose steadily in the air until the flying cord (a Manila rope three eighths of an inch in diameter) made an angle with the horizon of about 45° when the rope snapped under the strain. Tremendous oscillations of a pitching character ensued; but the kite was at such an elevation when the accident happened, that the oscillations had time to die down before the kite reached the ground, when it landed safely upon even keel in an adjoining field and was found to be quite uninjured by its rough experience. Kites of this type have a much greater lifting power than one would at first sight suppose. The natural assumption is that the winged superstructure alone supports the kite in the air, and that the boat body and floats represent mere dead-load and head resistance. But this is far from being the case. Boat-shaped bodies having a V-shaped cross-section are themselves capable of flight and expose considerable surface to the wind. I have successfully flown a boat of this kind as a kite without any superstructure whatever, and although it did not fly well, it certainly supported itself in the air, thus demonstrating the fact that the boat surface is an element of support in compound structures like those described.

Of course the use of a tetrahedral cell is not limited to the construction of a framework for kites and flying-machines. It is applicable to any kind of structure whatever in which it is desirable to combine the qualities of strength and lightness. Just as we can build houses of all kinds out of bricks, so we can build structures of all sorts out of tetrahedral frames, and the structures can be so formed as to possess the same qualities of strength and lightness which are characteristic of the individual cells. I have already built a house, a framework for a giant wind-break, three or four boats, as well as several forms of kites, out of these elements. See AËRODROME; BALLOON; FLYING MACHINES.

ALEXANDER GRAHAM BELL.

Aërians, a religious sect who arose in the 4th century of the Christian Church and present many features of modern religious liberalism in the way they combatted ecclesiastical tradition and the institutionalism professedly derived from the Apostolic age. They derive their name from their originator and leader, Aërius, a presbyter of Sebaste, a city of Pontus. Aërius flourished about 355 A.D. He was fired with a spirit of revolt against the condition of the Church as he found it. Although an ascetic of a very stern and rigid character, he was shocked at the extravagant lengths to which some of his fellow Christians carried the practice of fasting, and the claims which they made to merit because of this rigorous self-maceration. Although he found fasting a settled institution of the Church he opposed the practice because of the delusions it seemed to lead to. He was also an opposer

of those special festivals of intercession which were held in behalf of the faithful departed. "Pray for the living, whose needs and sufferings some of which you may have caused," he seems to say. To this vigorous and uncompromising onslaught on the common and ordinary practices of the Church he recalls such earnest and outspoken fathers of the Reformation as Martin Luther and John Knox. There were a great many people who sympathized and agreed with him, and his sect at one time was very flourishing. The ascendancy of the episcopal order in the Church was a natural aristocratic movement, although Bishop Lightfoot in commentary on the Philippians does not seem to think that it was sanctioned either by divine command or apostolic precedent. Aërius maintained that the bishop was not superior to the presbyter, that they were of the same order, and that a bishop was merely a chairman elected for convenience sake to preside among equals. He seems also to have been opposed to holding of any such set festivals in the Church as Easter. This sect seems to have sown the earliest seed of modern Presbyterianism.

Aërides, the wind flower, one of the *Orchidaceæ*, of which there are 15 species. The finest species, *Aerides adoratum,* grows wild in parts of Asia, but in cold and temperate climates is cultivated under glass, though flowering at rare intervals. This genus of plants derives its name from the fact that the species appear to take their principal nourishment from the air, as they can exist and thrive in their native clime, sending forth blossom after blossom while suspended and far away from any vegetable soil. They bear distichous leaves and their flowers are big and brilliant, while at the same time possessing a rare fragrance.

Aërial Telegraphy. See SEMAPHORE; WIRELESS TELEGRAPHY.

A'ërinite, a bright blue earthy substance found in the Pyrenees. It has no definite composition, and its blue color is perhaps of artificial origin.

A'ërodrome (from two Greek words signifying "air runner"), a form of flying-machine invented by Prof. S. P. Langley, now secretary of the Smithsonian Institution. This machine has never yet been constructed on a scale sufficiently large to sustain a man, but models weighing 30 pounds or so have been built, which, operated by a small steam engine, have worked successfully, and have given fair promise of the solution of the problem of aërial navigation. The aërodrome has no gas bag, but relies for its sustaining power wholly upon its wings and upon the machinery which propels it. Prof. Langley has approached the problem of aërial navigation with greater care and more elaborate preparation than any other man. For years before he undertook the construction of even the crudest of flying-machines he conducted an elaborate series of experiments upon a whirling table in which the supporting action of the air upon almost every conceivable shape of aëroplane, and at all possible velocities, was accurately measured and recorded. As his data, thus obtained, accumulated, he supplemented them by experiments with small models acting freely in the air; sometimes these were mere planes gliding through the air, and sometimes they were machines driven with screws propelled by rubber bands under tension. Having satisfied himself of the possibilities of mechanical flight, he calculated the areas of the sustaining surfaces that he would need, and the best shape to give them. Then came a long and elaborate series of investigations as to the motor best suited for the work, accompanied by the construction of a number of such motors, which were tested, weighed, and found wanting. His final choice was the steam engine, supplied with steam from a plain copper coil for a boiler, through which a circulation was artificially maintained, and which was heated by a gasolene flame from a special jet. Prof. Langley's work on the supporting power of aëroplanes is described in his 'Experiments in Aërodynamics.' He discovered the remarkable fact that in such aërial navigation as was there shown to be possible under certain definite conditions the power required would in theory diminish indefinitely as the speed of the flying-machine increased; and that it would actually diminish, even in practice, up to a certain limit. This apparently paradoxical fact is known as "Langley's law." In the completed form of his aërodrome there are two pairs of wings, which do not move like the wings of a bird, but are fixed to the machine and serve as supporting surfaces. These wings are slightly curved, and each is attached to a long central steel rod for support. From this same rod the body of the machine depends, together with the boiler, the engine, the machinery and the propeller wheels, these latter not being in the position of those of an ocean steamer, but more nearly amidships. They are made of wood, and are between three and four feet in diameter. The boiler supplies steam for an engine of between one and one-and-a-half horsepower; and weighs a little over five pounds, including the fire grate. The engine, with all its moving parts, weighs 26 ounces, and suffices to drive the propeller wheels at a speed of from 800 to 1,200 revolutions per minute. The rudder has both a horizontal and a vertical blade, so as to steer in both directions. The total length of the machine is about 16 feet, and the span of the wings from tip to tip is between 12 and 13 feet. The weight of the whole, including the machinery, is nearly 30 pounds. On the day when the aërodrome made its first successful flight from a houseboat on the Potomac River, at its first launching it made a short, sharp dive into the river. No change was made other than a slight adjustment whereby the centre of gravity of the whole machine was moved about three quarters of an inch; but this was sufficient to give the desired balance, and the second launching was entirely successful.

Prof. Alexander Graham Bell, in 'Nature' for 28 May 1896, describes the famous trial on the Potomac River as follows: "Through the courtesy of Mr. S. P. Langley, secretary of the Smithsonian Institution, I have had on various occasions the privilege of witnessing his experiments with aërodromes, and especially the remarkable success attained by him in experiments made on the Potomac River on Wednesday, 6 May, which led me to urge him to make public some of these results. I had the pleasure of witnessing the successful flight of some of these aërodromes more than a year ago, but Prof. Langley's reluctance to make the results public at that time prevented me from asking

him, as I have done since, to let me give an account of what I saw.

« On the date named two ascensions were made by the aërodrome, or so-called ‹ flying-machine,› which I will not describe here further than to say that it appeared to me to be built almost entirely of metal and driven by a steam engine, which I have understood was carrying fuel and a water supply for a very brief period, and which was of extraordinary lightness. The absolute weight of the aërodrome, including that of the engine and all appurtenances, was, as I was told, about 25 pounds, and the distance from tip to tip of the supporting surfaces was, as I observed, about 12 or 14 feet. The method of propulsion was by aërial screw propellers, and there was no gas or other aid for lifting it in the air except its own internal energy.

« On the occasion referred to the aërodrome at a given signal started from a platform about 20 feet above the water and rose at first directly in the face of the wind, moving at all times with remarkable steadiness, and subsequently swinging around in large curves of perhaps a hundred yards in diameter, and continually ascending until its steam was exhausted, when, at a lapse of about a minute and a half, and at a height which I judged to be between 80 and 100 feet in the air, the wheels ceased turning, and the machine, deprived of the aid of its propellers, to my surprise, did not fall, but settled down so softly and gently that it touched the water without the least shock, and was in fact immediately ready for another trial.

« In the second trial, which followed directly, it repeated in nearly every respect the actions of the first, except that the direction of its course was different. It ascended again in the face of the wind, afterward moving steadily and continually in large curves accompanied with a rising motion and a lateral advance. Its motion was, in fact, so steady that I think a glass of water on its surface would have remained unspilled. When the steam gave out again it repeated for a second time the experience of the first trial when the steam had ceased, and settled gently and easily down. What height it reached at this trial I cannot say, as I was not so favorably placed as in the first, but I had occasion to notice that this time its course took it over a wooded promontory, and I was relieved of some apprehension in seeing that it was already so high as to pass the tree tops by 20 or 30 feet. It reached the water one minute and thirty-one seconds from the time it started, at a measured distance of over 900 feet from the point at which it rose. This, however, was by no means the length of its flight. I estimated from the diameter of the urve described, from the number of turns of the propellers as given by the automatic counter, after due allowance for slip, and from other measures, that the actual length of flight on each occasion was slightly over 3,000 feet. It is at least safe to say that each exceeded half an English mile.

« From the time and distance it will be noticed that the velocity was between 20 and 25 miles an hour, in a course which was constantly taking it ‹ up hill.› I may add that on a previous occasion I have seen a far higher velocity attained by the same aërodrome when its course was horizontal.

« I have no desire to enter into detail further than I have done, but I cannot but add that it seems to me that no one who was present on this interesting occasion could have failed to recognize that the practicability of mechanical flight had been demonstrated.

« ALEXANDER GRAHAM BELL.»

The aërodrome is described, with illustrations, in the ‹ Scientific American Supplement,› Nos. 1404 and 1405; and there was also a popular account in ‹ McClure's Magazine › for June 1897. See also « Story of Experiments in Mechanical Flight,» by S. P. Langley, in the Smithsonian ‹Report› for 1897. For further information on the subject of aërial navigation, see BALLOON; FLYING-MACHINE.

Aërodynam'ics, that branch of hydrodynamics (q.v.) which deals with the properties, and especially the motions, of air and other compressible fluids. See METEOROLOGY.

A'ërolite, a name given to stones falling from the sky. See METEORITE.

Aërol'ogy, that branch of physics that treats of the air. See ATMOSPHERE; METEOROLOGY.

Aëronau'tics, the art of navigating the air by means of balloons (q.v.) or flying-machines (q.v.). See also AËRODROME; AËROPLANE; BALLOON.

A'ëroplane. This word is used in the following two senses: (1) A plane or nearly plane material surface possessed of a certain degree of rigidity, and used in connection with flying-machines to oppose great resistance to the fall of the machine, while allowing it to travel ahead without much resistance. The planes are usually set parallel with the horizontal axis of the machine, or else they are inclined slightly upward so that as the machine is driven forward by its propellers or wings the aëroplane will exert a lifting or sustaining effect. (2) Any flying-machine, but especially that invented by M. Victor Tatin, and tested with a certain degree of success in 1879 at Chalais-Meudon. Tatin's aëroplane was propelled by two screws, which were driven by compressed air. The syllable -plane, in the word in its second sense, is derived from the Greek word *planos*, "wandering." See AËRODROME; BALLOON; FLYING-MACHINE.

Aërosi'derite, a meteorite (q.v.) consisting essentially of metallic iron.

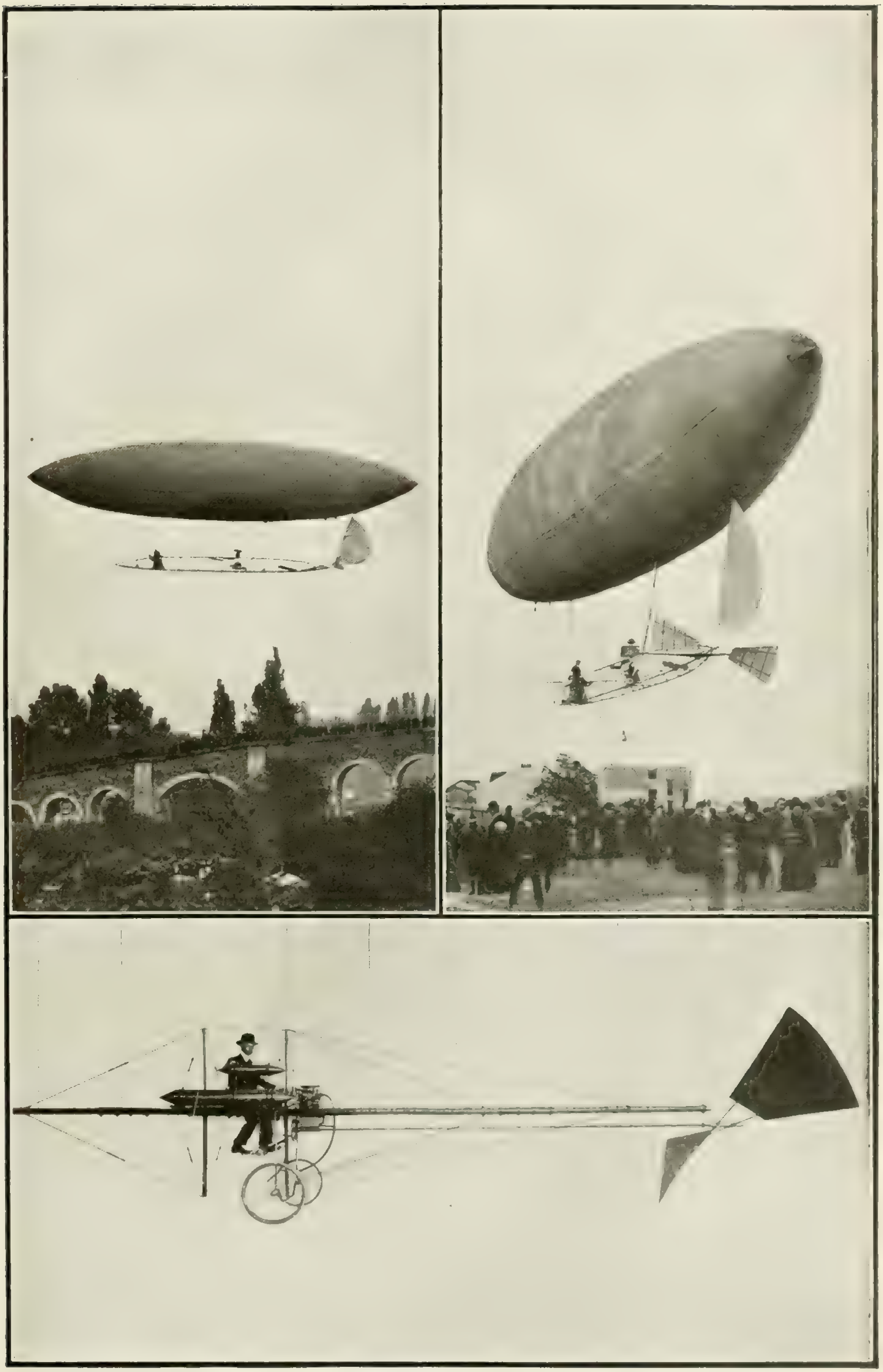
Aërosid'erolite, a meteorite (q.v.) containing both stone and iron. The name comes from the Greek *sideros*, iron, and *lithos*, stone. It was first given by N. S. Maskelyne.

A'ërostat. See BALLOON; FLYING-MACHINE.

Aërosta'tics, that branch of science which treats of the density, pressure, and equilibrium of air and other gases. See GASES, GENERAL PROPERTIES OF; THERMODYNAMICS.

Aërotherapeutics, the treatment of disease through the medium of air. See THERAPEUTICS.

Æschines, es'ki-nēz, the greatest of Greek orators except his rival Demosthenes: b. Attica, 389 B.C.; d. Samos, 314 B.C. That he rose to immense influence and high station by his unaided genius, despite family poverty, would be



[1] Departure of Mr. Santos-Dumont from the Aerostatic Park on his successful trip on which he won the Deutsch Prize of $20,000. [2] The "Santos-Dumont No. 6" maneuvering in midair. [3] Ascent of the Santos-Dumont Dirigible Balloon No. 5 at Longchamps on July 12th.

considered his best title to honor in democratized modern states: it was charged against him as a foul disgrace in Athens. The further « campaign » accusations of Demosthenes — that his father was a schoolmaster's freedman and his mother a public dancer and courtesan, and that he changed the family name to a more genteel form — are valuable only as examples of what passed then for fatal obstacles to public trust and private honor, and the last-named reads curiously in a modern atmosphere. That his father was a poor schoolmaster, and that he worked in the school to help, is probable; more than probable also are his boasts of good blood despite it, as several of the brothers became leading citizens, one of them being on the board of ten *strategoi* which conducted military and foreign affairs. He may have been, as alleged, a professional gymnast: unpaid athletics were too reverently worshipped there to make paid ones seem unnatural. He certainly served a long term of military duty (probably not all at once), and with distinction; for he was in the battles of Mantinea (362) and Tamynæ (349), and for bravery in the latter was deputed to carry home the news and accorded a crown. Meantime he had become a magistrate's clerk; a petty actor; finally secretary to the important political leaders Aristophon and Eubulus, who helped him twice to an election as government secretary. He was now 40 and had not « found himself »; but with the chance of addressing the public his true talent soon became manifest. He quickly acquired an eminent mastery of legal and political knowledge, and became a singularly graceful and effective speaker, with remarkable finish, harmony, and variety of oratorical effect. In 348 he was sent to the Peloponnesus to organize a union of the Greeks against Philip of Macedon, but failed entirely, and doubtless became convinced at that time that any such scheme was permanently impracticable. The next year he went as one of the embassy to negotiate peace with Philip, and on their report (which Grote pronounces « a tissue of impudent and monstrous falsehoods,» not necessarily of their own invention, but acceptance of Philip's word), the Peace of Philocrates (another envoy) was concluded in 346. Philip grew more and more powerful, and Demosthenes more and more urgent for opposition to his plans, which, however plausible,— a Græco-Macedonian union against the barbarians and the East,— could in practice only be carried out, as they at last were, by absorbing Greece in Macedonia. Æschines as steadily supported the Macedonian alliance, and doubtless as honestly, from conviction that for disunited Greece the only choice was between league and conquest — which also was true. In 345 Demosthenes charged him with treason and bribery. He was acquitted without difficulty. Three years later the charge was renewed in Demosthenes' great speech « On the False Embassy »: Æschines rebutted it with success in his speech of the same title. He helped on the Macedonian cause all through the reign of Philip and the early part of Alexander's, accused by the opposing party of being a hired emissary of Macedonia, and returning as much and presumably as just abuse as he received. That the public made the necessary discount is proved by the fact that he lost no credit with them. At last he assumed the aggressive with disastrous results. One Ctesiphon having proposed a golden crown for Demosthenes in recognition of his services to the commonwealth, Æschines impeached him for proposing an illegal act, and made his greatest speech, « Against Ctesiphon,» an indictment of Demosthenes' entire public life. Demosthenes replied with *his* greatest, « On the Crown »; so crushing that though the pro-Macedonian party was in the ascendant Æschines could not obtain the one-fifth minority of votes legally necessary to save him from *atimia*, or infamy, and a fine of 1,000 drachmas. He left Athens at once without paying it, and thereafter taught rhetoric or schools of oratory in foreign parts; some say Ionia and Caria, and finally Rhodes after Alexander's death. He died at Samos, aged 75. Three of his orations are extant,— against Timarchus' charge of bribery after his second embassy to Philip, one on that embassy, and the one against Ctesiphon. There is a story that he read the latter to his pupils at Rhodes, and on their professing to be astonished that despite its brilliancy he should have been defeated, replied, « You would not be if you had heard Demosthenes.» A variant is that he read Demosthenes' speech as a model of rhetoric, and on their expressing admiration, replied, « If you had heard him roll it out himself! » (The originals are in countless editions. See for text and best comment, Jebb's ‹ Attic Orators,› London 1876–80. Translations are also plentiful.)

Æschylus, es'ki-lus, the eldest of the three great tragic poets of Greece: b. Eleusis, Attica, 525 B.C.; d. 456. Euphorion, his father, was probably connected with the mysteries of Demeter, and he is said himself to have been initiated. In 499 B.C. he made his first appearance as a competitor for the prize of tragedy, but was not successful. Before attaining his first triumph he had to appear as an actor on a grander scene. He was present, and highly distinguished himself, at the battles of Marathon, Artemisium, Salamis, and Platæa. He must have gained as a poet by his experience in this momentous struggle, and probably too his fame as a warrior would help to recommend his compositions as a poet to his countrymen. His first dramatic victory was achieved in 484 B.C. The names of the pieces which composed his trilogy at this time are not known. The ‹ Persæ › (‹ Persians ›), the earliest of his extant pieces, formed part of a trilogy which gained the prize in 472 B.C. Altogether he is reputed to have composed 70 tragedies and gained 13 triumphs. In the satirical pieces which accompanied the trilogy of tragedies he is said also to have been a master. Only seven of his tragedies are extant. They are: ‹ The Persians › (remarkable as being founded on contemporary events), ‹ The Seven against Thebes,› ‹ The Suppliants,› ‹ Prometheus Bound,› ‹ Agamemnon,› ‹ The Choephori,› and ‹ The Eumenides.› The last three form the trilogy of the ‹ Oresteia › (so named as being based on the story of Orestes), the only complete Greek trilogy we possess. It was represented in 458 B.C., between which date and that of ‹ The Persians › the others were brought out; but, according to a suggestion of Böckh, the representation of the ‹ Oresteia › in 458 B.C. was a repetition in the absence of the poet.

In 468 B.C. he was defeated by Sophocles, and is said to have retired through mortification at this defeat to the court of Hiero, king of Syracuse. Of the fact of his residence at Syracuse at this time there appears to be no doubt, and without ascribing his retirement to mere jealousy, there are other reasons for associating it with his defeat. Æschylus belonged to the old aristocratic party, which had long been on the decline. His rival Sophocles, whose first appearance as a dramatist had thus been honored with a triumph, was favored by the democratic party, Cimon himself being one of the judges. The decline of his party might thus render Athens an uncongenial residence to Æschylus, and indispose him for an arduous contest in which he did not feel that justice was done to his claims. During his residence at Syracuse he composed many pieces, in which he not only selected local subjects, but used words unintelligible to the Athenians. Unless Böckh's theory is received it must be supposed that Æschylus returned to Athens for the representation of his ‹Oresteia.› There is a story that he was accused before the Areopagus for impiety either in representing the « Eumenides » on the stage or in divulging the mysteries of Demeter; and it is to the period of this representation that the accusation is usually referred. If Æschylus came to Athens he must soon have returned to Sicily, where he died in Gela. A tomb was erected to him, with an epitaph by himself, in which he speaks of himself as an exile from Athens, and refers to his part in the battle of Marathon, but not to his writings. Of the manner of his death an improbable story is told, namely, that an eagle, mistaking his bald head for a stone, let fall a tortoise on it to break the shell, and thus killed him.

Æschylus was in a sense the creator of the Greek tragedy, the stage up till his time being occupied with comparatively feeble productions. His style, as is common with early poets, was grand, sublime, and full of energy, though sometimes erring in excessive splendor of diction and imagery. Longinus, the celebrated Greek critic, complains of it as being often harsh and overstrained. His plays have little or no plot, and in personal portraiture he does not represent the subtle complexities of human character, which belong to a later development of art, but the bold outlines of strength and daring which pertain to the conception of gods and heroes. A fatalistic tendency dominates his views of the unseen, and by making men the sport of superior beings supplies abundant material for tragedy. An ethical principle of retribution is not, however, wholly lost sight of. The practice of contending for the prize with a trilogy of plays was established before his time, but he was the first to reduce the trilogy to a unity by linking together three distinct but associated subjects, each of which formed the theme of a play complete in itself yet related to the others.

Æschylus was a great improver of the stage as well as of the drama. He introduced a second actor upon the scene, and was thus the founder of true dramatic dialogue, to which he subordinated the chorus, which had formerly been the principal part. At a subsequent period he followed the example of Sophocles in introducing a third actor. The dialogue he introduced was measured and formal, and without the license of broken lines. This gave it a distant and stately character agreeable to the kind of superhuman heroes which it suited the genius of Æschylus to put upon the stage. To make the appearance of his personages suitable to their character, he introduced the thick-soled cothurnus or buskins to raise the stature of the actors, and he gave them dresses appropriate to the parts they had to play. He himself sometimes acted in his own plays. He also made use of the scene-painter's services, and Agatharchus is said to have painted for him the first scenes drawn according to the laws of linear perspective. From the testimony of Aristotle, however, it seems to be doubtful whether scene-painting was actually introduced by Æschylus or Sophocles. After its introduction it would no doubt be used by both. He carefully trained the dancers to represent incidents in the play by appropriate action, and he removed from the stage scenes of violence and blood. By a special decree of the Athenian people a chorus was provided at the public expense for any one who wished to produce any work of Æschylus a second time. After his death his sons Euphorion and Bion, and his nephew Philocles, gained triumphs with works of his over Sophocles and Euripides, and thus was established a tragic school of Æschylus, which continued to flourish for more than a century.

The first edition of Æschylus was printed in Venice in 1518. The best of the earlier editions was that of Stanley (London, 1663). The best recent editions are those of Ahrens (Paris, 1877), Wecklein (Berlin, 1884) and F. A. Paley (in the ‹Bibliotheca Classica›). There are English poetical translations by Potter, Blackie, Plumptre, Morshead, and Swanwick, and a prose translation by Paley. Fitzgerald's semi-translation of the ‹Agamemnon,› with the widest liberties of omission, addition, and recasting, though of no very great service to the scholar, is of incomparable poetic brilliancy, and far the best introduction to make the general reader feel Æschylus' greatness and charm. Robert Browning also has one of the same play, and Elizabeth Barrett Browning one of the ‹Prometheus.›

Æs'chynite, es'ki-nīt, the mineral for which Dana's Æschynite group was named. It is essentially a niobate, titanate and thorate of the cerium metals, containing also iron and calcium in small amounts. It occurs in black, prismatic, vertically striated crystals belonging to the orthorhombic system. Its hardness is about 5.5, and its specific gravity about 5. It is rare, and occurs in the Ural Mountains, in Norway, and in Silesia. It was named by Berzelius from a Greek word meaning "shame," in allusion to the "shameful" inability of chemistry, at the time of its discovery, to separate titanic acid and zirconia (two of its constituents).

Æscula'pius (Greek *Asclepios*), the god of medicine among the ancient Greeks and Romans. In Homer he is merely a man, the god of medicine being Pæëon; the deification was probably founded on the Homeric story, and at any rate was subsequent. The notion that he was originally a god of light or the underworld, « reduced » to the tradition of a human being,

inverts all historic processes and the nature of early thought. In Homer he has two sons, Machaon and Podalirius, famous as heroes and physicians; they are called Asclepiadæ, a name retained by their descendants or at least a priestly physician-caste. His daughters, Hygeia (health), Panacea (all-healer), Iaso (healer), etc., are later inventions, abstractions of relevant ideas. The later myths vary: some call him son of Apollo and Arsinoe, some of Apollo and Coronis daughter of Phlegyas. In Hesiod the nymph was faithless, and with her bridegroom Ischys (one of the Lapithæ) was slain by the gods (the raven who brought the news being changed from black to white as a punishment); but Apollo rescued his unborn son from the mother's body on the funeral pile, and put him under charge of Chiron, where he grew to excel his master, able not only to prevent death but to raise the dead. At Pluto's complaint Zeus slew him with a thunderbolt, and after his death he received divine honors. The supposition that his worship originated in the Peneus Valley in Thessaly is perhaps due to the Homeric tradition being our earliest record; but if he was originally a healer wonderful to rude barbarians, it is likely enough that the tradition was Thessalian. Anyway, Tricca there was an old focus of his cult; but it flourished also to the south, perhaps carried there by the Thessalians forced southward by invaders. It had noted seats in Phocis, Bœotia, and especially in the Peloponnesus, where Thelpusa in Arcadia was one familiar seat; but by far the greatest was Epidaurus south of Corinth. Here was a temple in a grove, where the sick had to spend a night, and the proper remedies were revealed to the priests in a dream, and the cured made sacrifice to Æsculapius, commonly a cock. The sleep was of course a mere part of the priests' mystification; but from their accumulated experience and their register of cases they must have became really expert physicians for the times. From thence the worship spread all over Greece and the islands and to Rome,— nearly 200 temples in all; there were celebrated ones at Cos, Cnidus, and Pergamus; the cult was introduced into Athens as late as 420 B.C., and to Rome 293 B.C., in consequence of a plague. (Walton, ‹The Cult of Asklepios,› New York, 1894; Wilamowitz-Möllendorff, ‹Isyllus von Epidauros,› Berlin, 1886.)

Æs'culin, es'cu-lin, a bitter principle found in the bark of the horse-chestnut tree (*Æsculus hippocastanum*), especially in the spring, before the buds open. It crystallizes in small prisms having the formula $C_{15}H_{16}O_9.2H_2O$. Æsculin melts at 400° F. It dissolves sparingly in cold water, but easily in boiling water, the solution coagulating upon cooling. It is soluble in glacial acetic acid and in 24 parts of boiling alcohol. Æsculin is of special interest to the physicist on account of the notable bluish fluorescence (q.v.) exhibited by its solution in water. The word is also spelled æsculine, esculin, and esculine.

Æ'sop, the fabulist. As early as the mid-5th century B.C. at least, fables were circulating in Athens attributed to a certain Æsopus, and held in such esteem that the city erected to him a statue by the great sculptor Lysippus; Aristophanes makes one of his characters learn the fables, Socrates versified such as he could remember, and Plato speaks of them with approval; Herodotus, born c. 484 B.C., specifically tells us, as referring to a story too familiar to repeat, that when the Delphians offered compensation for his murder to the rightful claimant, it was claimed and received by one Iadmon, grandson of another Iadmon, a Samian and owner of Rhodopis the courtesan, who lived under Amasis, king of Egypt (c. 570–526 B.C.), and was redeemed by Charaxus, the brother of Sappho. That all this mass of detail concerning persons living less than a century before his time, with easily verifiable dates, and about one whose fate was notorious, was in fact told of a myth and abstraction, and that there never was an Æsop, is exaggerating skepticism into absurdity; and the later accretion of fables and confusion of persons is irrelevant. Plutarch (late 1st century A.D.) fills out the story from lost authors, possibly with authentic traditions, perhaps mixed with real myth-making: that he was captured young and brought a slave to Athens, and after several changes of ownership enfranchised by Iadmon (which is inconsistent with Herodotus); that during Pisistratus' usurpation he visited Athens and composed the fable of «King Log and King Stork» for the edification of the citizens; that, going to the Lydian court, he became Crœsus' favorite, was sent by him as envoy to Delphi to distribute money to the people (about 564 B.C.), and, refusing to do so on account of a quarrel among them, was thrown from a cliff by them. This at least coheres with Herodotus. The stories of his being an ugly blackamoor, and others beyond the above, are derived from a worthless life of him published (but not written) by Maximus Planudes (q.v.), a 14th-century monk, in which he is apparently confounded with the mythical Oriental sage Lokman. As to the fables, it is probable that Æsop did not write them down, but merely told them to audiences: and it is perfectly certain that the ones we have under his name are not his (though they may incorporate the same incidents), but substantially a collection made from oral memories by Demetrius Phalereus of Athens about 320 B.C.; turned into Latin by Phædrus of the 1st century A.D., with additions of his own much inferior in every way; versified by Babrius, a Greek poet of perhaps the late 1st century; and variously translated and re-edited since. The usual popular «Æsop» is Phædrus. The origin of the fables is largely Oriental; but they are much superior to any Oriental prototypes in pith and conciseness. It is often said also that they are part of the stock of beast-apologues common to the entire Indo-European races; but this is true only in the sense that animals have been made to talk in all old folk-lore. The special qualities of «Æsop»— the immense compression of idea almost to «indecent exposure,» in Sydney Smith's phrase, the sweep of generalization, the acute analysis of typical human characteristics — make it unique; and it quite probably inherits these traits from the genius of the real Æsop, a Greek of the mighty age of Greece.

Æso'pus, Clodius, a celebrated Roman actor of the 1st century B.C., a contemporary of Roscius. When acting he entered into his part to such a degree as sometimes to be seized with a perfect ecstasy. Plutarch mentions a report

concerning him while representing Atreus, that, deliberating how he should revenge himself on Thyestes, he was so transported beyond himself that he smote one of the servants who was crossing the stage and killed him on the spot. He was a dramatic tutor of Cicero, and befriended him in exile. His last appearance was at the dedication of Pompey's Theatre in 55 B.C.; his voice thereafter failed. His folly in spending money on expensive dishes made him as conspicuous as his dramatic talents. He is said, at one entertainment, to have had a dish filled with singing and speaking birds, which cost $4,000. His son Æsop inherited his father's worst traits: it was he who drank the $40,000 pearl dissolved in vinegar, to be noted as having drunk the most expensive known beverage.

Æsthetics, the science of beauty, in its emotions or attributes. The term æsthetics first received this application from Baumgarten, a German philosopher, who was the first modern writer to treat systematically on this subject. Kant uses the word æsthetics (*aisthetikos*, perceivable by the senses) in a broader etymological sense, treating in his transcendental æsthetic of the *a priori* principles of sensuous knowledge. There are, as indicated, two modes of treating æsthetics, scientifically or empirically, by collection and collation of the objects or associations by which the æsthetical emotions are excited, and philosophically by analysis and determination of the cause or source and mode of the emotions. Neither of these modes is independent of the other; but the scientific mode, from the multitude of details it involves, is little amenable to summary treatment, and in form at least we shall be compelled to limit ourselves to the other.

Æsthetics, like every other branch of philosophy, has suffered from the conflict of first principles which has continually impeded the development of details; but it has also profited by this conflict, which has itself brought out facts which might otherwise have been hid. Space will not permit a historical summary, and we confine ourselves to the briefest indications of the views of the leading thinkers.

Socrates, according to Xenophon, regarded the beautiful as coincident with the good, and both as resolvable into the useful. Plato, in accordance with his idealistic theory, held the existence of an absolute beauty, which is the ground of beauty in all things. He also asserted the intimate union of the good, the beautiful, and the true. Aristotle, whose contributions to æsthetics are of the highest value, treated of them in much more detail than Plato, but chiefly from the scientific or critical point of view. In his « Poetics » he declares poetry to be a more serious and philosophical matter than philosophy itself. In his treatises on « Poetry » and « Rhetoric » he lays down a theory of art and establishes principles of beauty. His philosophical views were in many respects opposed to those of Plato. He does not admit an absolute conception of the beautiful; but he distinguishes beauty from the good, the useful, the fit, and the necessary. He resolves beauty into certain elements, as order, symmetry, definiteness, and a certain magnitude, which appears to be relative to the perceptive capacity. A distinction of beauty, according to him, is the absence of lust or desire in the pleasure it excites. Beauty has no utilitarian or ethical object; the aim of art is merely to give immediate pleasure; its essence is imitation; the chief objects of imitation in poetry and music are passions, dispositions, and actions. The essence of poetry consists in this imitation, and not in form. The end of tragedy, he says, is to effect a purification of pity and fear by means of these passions themselves. He also speaks of a purifying effect of music in quieting wilder forms of excitement. As this seems a contradiction of his negation of an ethical end in æsthetics it has been disputed whether this purification is ethical or æsthetical. Plotinus agrees with Plato and disagrees with Aristotle in holding that beauty may subsist in single and simple objects, and consequently in restoring the absolute conception of beauty. He differs from Plato and Aristotle in raising art above nature. When the artist has *logoi* (the equivalent in the system of Plotinus of the ideas in that of Plato) for his models his creations may be more beautiful than natural objects. Baumgarten's treatment of æsthetics is essentially Platonic. He made the division of philosophy into logic, ethics, and æsthetics; the first dealing with knowledge, the second with action (will and desire), the third with æsthetics.

Where Baumgarten fails of a Platonic standard is in limiting æsthetics to the conceptions derived from the senses, and in making them consist in confused or obscure conceptions, in contradistinction to logical knowledge, which consists in clear conceptions. Kant defines beauty in reference to his four categories, quantity, quality, relation, and modality. In accordance with the subjective character of his system he denies an absolute conception of beauty, but his detailed treatment of the subject is inconsistent with the denial. Thus he attributes a beauty to single colors and tones, not on any plea of complexity, but on the ground of purity. He holds also that the highest meaning of beauty is to symbolize moral good, and arbitrarily attaches moral characters to the seven primary colors. The value of art is mediate, and the beauty of art is inferior to that of nature. He classifies the arts according as they express the (subjective?) æsthetic idea. The treatment of beauty in the systems of Schelling and Hegel can with difficulty be made comprehensible without a detailed reference to the principles of these remarkable speculations. Idealistic systems, which, to say the least, it is difficult to distinguish from pantheism, while it is impossible to find a beauty and even sublimity in the boldness of their developments, they may be described from an outside point of view as exaggerations of Platonism, in which human consciousness is made the exhaustive measure of universal being. The control of subject and object, which with Schelling constitutes the absolute, is seen in artistic conception within the limits of the ego, and a feeling of infinite satisfaction accompanies this perfect perception by intelligence of its real self. Art accordingly is higher than philosophy, and the beauty of art is superior to the beauty of nature. Schelling's views of art are not clearly developed into particular criticism. In tragedy he finds a conflict of liberty in the subject with objective necessity. In art, according to Hegel, the absolute is immediately present to sensuous perception. With him, as with Schlegel, it is the highest revelation of beauty and superior to

nature. The beautiful is the shining of the idea (the Hegelian idea, or absolute notion into which all existence is resolvable) through a sensuous medium. Its essence accordingly is in appearance, and in this it differs from the true. Its complement is religion, which embodies the certainty of the idea.

Hegel classifies the arts according to the supremacy of form and matter, a classification which appears somewhat superficial and is very open to criticism. He treats of beauty in much detail, and where he is not Hegelian he is essentially Platonic. The extravagance of Hegelianism, along with its pantheistic tendencies, become more pronounced in the systems of the followers of Hegel, into which we have not space to enter. English writers on beauty are numerous, but they rarely ascend to the heights of German speculation. Shaftesbury adopted the notion that beauty is perceived by a special internal sense; in which he was followed by Hutcheson, who held that beauty existed only in the perceiving mind, and not in the object. Numerous English writers, among whom the principal are Alison and Jeffrey, have supported the theory that the source of beauty is to be found in association — a theory analogous to that which places morality in sympathy. The ability of its supporters gave this view a temporary popularity, but its baselessness has been effectively exposed by successive critics. Dugald Stewart attempted to show that there is no common quality in the beautiful beyond that of producing a certain refined pleasure; and Bain agrees with this criticism, but endeavors to restrict the beautiful within a group of emotions chiefly excited by association or combination of simpler elementary feelings. Herbert Spencer avails himself of a hint supplied by Schiller, which he makes subservient to the theory of evolution. He makes beauty consist in the play (sport) of the higher powers of perception and emotion, defined as an activity not directly subservient to any processes conducive to life, but being gratifications sought for themselves alone. He classifies æsthetic pleasures according to the complexity of the emotions excited, or the number of powers duly exercised; and he attributes the depth and apparent vagueness of musical emotions to associations with vocal tones built up during vast ages. Among numerous writers who have made valuable contributions to the scientific discussion of æsthetics may be mentioned Winckelmann, Lessing, Jean Paul Richter, the Schlegels, Gervinus, Helmholtz, and Ruskin.

The theory of Plato affords, we believe, the true basis both of philosophical apprehension and of scientific investigation of the beautiful. What is meant when it is said there is no common quality in what is recognized as beauty beyond the excitement of a pleasurable emotion? It is not pretended that all pleasurable emotions are comprehended in the notion of beauty: the mere excitement of pleasure is not then sufficient to distinguish the notion. Is the use of the term then a mistake, and does it imply nothing more than the arbitrary grouping together of some pleasurable emotions to the exclusion of others? We have the most conclusive psychological evidence in the structure of all languages that this is not the case, and that there is some notion, simple or complex, subjective or objective, requiring this term to express it. If, then, we attempt to distinguish between pleasurable emotions, and to group them as emotions of beauty or emotions not of beauty, we must either suppose our emotions to be self-excited, or we must assume a corresponding difference in the exciting cause. We have thus got both an objective and a subjective beauty and it remains to inquire into the nature of the object, whether real or phenomenal, simple or complex, by which the notion of beauty is excited. Association cannot be an original cause of the emotion, for association as such, and without regard to the nature of the association, can excite no definite emotion such as that of pleasure. If the notion of beauty then is actually excited by association, as it undoubtedly is, it remains to be inquired by what association, and by what elements of the association? Nor can the explanation of Aristotle and other philosophers be received, that beauty is merely a recognition of harmony, proportion, symmetry, and such modes in complex objects, for it is as undoubted that there is a self-beauty, the beauty of a straight line in being straight, of a circle in being round, or of blueness in being blue, as that there is a beauty of harmony and proportion. Lastly, we cannot limit beauty to the objects of the senses; all that is perceived by intelligence, whether in the forms or processes of matter, or in the states or operations of mind, is capable of exciting the emotion of beauty. There is then no common category in which the beautiful can be included except the beautiful. It is not the useful, or the good, or the true, the great or small, the high or low, but the beautiful. But Plato has also shown that our ideas, though not resolvable into each other, are mutually dependent and related. They are united in concrete thought and apprehension, and they form in their totality a whole which constitutes the oneness of intelligence. If beauty then cannot be resolved into other notions, its relations to and combinations with these notions can be traced, and this constitutes its philosophical definition.

Our knowledge is indeed too limited to enable us to trace all the relations of ideas which are infinite, but a just use of psychology enables us to apprehend in their simplest form even the highest verities, and Plato, in associating in one triad beauty, goodness, and truth, has expressed the highest relation and evolved the highest knowledge attainable of them. The psychological evidence of this union lies within the range of experience, and its generalization is the legitimate operation of reason. To a limited intelligence goodness and truth (or reality) seem often wide apart, but every intelligence must apprehend the desirableness of their union, and occasionally witness practical exemplifications more or less perfect of it. If uniting such partial realizations we assume that to a perfect intelligence truth and goodness would be in perfect unity, the contemplation of this union will excite in us the highest emotion of beauty. This, then, may be regarded as both the type and the exhaustive realization of the notion of beauty. This trinity has, as indicated also by Baumgarten, a relation to the distribution or natural operation of our faculties. We have reason to apprehend truth, imagination to perceive beauty, and conscience to recognize goodness. Imagination as a mental faculty must not

be understood as a mere power of reproducing objects of sense in the form of pictorial images. It is the mental power by which we apprehend and combine at will all the elements directly presented to our consciousness, whether from external observation or internal experience. It, as well as reason, is operative, but it differs from reason both in its mode of operation and in its end. Instead of the slowly elaborate process by which reason searches out the true relations of its objects, it seeks by the readiest process objects of immediate contemplation on which it can dwell with satisfaction, and accordingly selects for combination those elements which present to it the most immediate affinities. In its constructive data it is as comprehensive as reason, but in its processes it is less sure. It even forms hypotheses, that is, semblances of reason, but it leaves reason to verify them. Hence the reason why the perception of the beautiful has been assigned to an inner sense. Hence also the reason why the apprehension of beauty separates itself from the apprehension of truth and of goodness.

The apprehension of beauty is always the apprehension of some perfection, of some identification of the good in the real, but in order to produce the emotion of beauty this identification must be manifest. This it is, and this alone apparently, which associates beauty with the work of imagination rather than with the work of reason, and makes the former the special faculty of beauty. The processes of reason are slow and their results remain long imperfect; thus there is no immediate realization of the perfection of truth attained by them; but when some final discovery completes a chain of reasoning, and a whole truth stands revealed, there is an immediate perception of goodness in the completed truth, and the emotion of beauty is at once evoked. The work of imagination is subject to the review of reason, but as reason and imagination work on the same fundamental principles, it is the application of these principles alone which reason can review. Particular manifestations of beauty are thus capable of analysis, and we may resolve the elements of the most complex manifestations into two, self-beauty and beauty of combination. The first exists when the simple type or idea is realized in the example, when a straight line is straight, a circle round, a color or a sound pure. When a type is suggested by simulation, on the contrary, but so imperfectly realized that the defect is apparent, the result is ugliness. It thus needs no metaphysics to distinguish beauty from its opposite. In combination beauty is given when perfect types are combined according to laws of symmetry, proportion, and design. Every single curve, for example, has a particular law, and that curve is beautiful when produced according to its law: but when a variety of curves are combined according to some law of symmetry in one outline, there is, besides the self-beauty of the several curves, a beauty in the observance of the law of combination, and in this complex beauty of outline, besides the manifested beauty of form, there may be suggested beauties of suppressed continuations. So with combinations of sound and color and more complex combinations, as in the forms of animal and vegetable life.

Two related laws of beauty in combination appear to be the production of the greatest variety with the least expenditure of means, and the repetition under slight modifications of similar forms. The latter from the comparisons it suggests has a highly educative effect on the perceptive faculties. Thus all the canons of beauty are absolute, but as these canons are applicable only to the elements, whether of self-beauty or of combination, and as we are ignorant of the laws which determine the number and variety of the more complex combinations, which we learn to know only by observation and comparison, principles of criticism only can be formed, and no absolute standard of taste for common empirical observation. Diversities of opinion are thus easily accounted for. The existence of beauty in the object is distinct from its perception, and in a complex object each observer will perceive only those beauties which the capacity and training of his own faculties enable him to perceive. Even the demonstration to reason of the observance of a law of beauty will not help a defective capacity. The instrumentality of our senses in interpreting to us the beauties of nature demands particular attention. Beauty in an object implies relation of the object to mind in which the canons of beauty exist, but not surely to the perceiving mind only, but also to the conceiving or creating mind. The perception of beauty thus establishes a community between the perceiving and the creating mind. It is an evidence of the validity of the information we derive from those operations of our senses which are deemed most arbitrary. It is the stamp of the Creator on the instruments of our faculties.

It is easily possible for art within a narrow range to excel nature, for while nature supplies our types she rarely carries out in any individual example all the details of typical excellence variously presented. The whole causes of these deviations of nature from her own standards it is impossible to assign, but observation shows that ethical causes have a place among them, and the best reason of men has always inclined to give them a larger place than actually appears. In this also art imitates nature, but in this wider sphere to suppose that art could excel nature would be to assume the superiority of man to the Author of nature. There is thus no ethical indifference for art. To limit it to the mechanical imitation of nature, or the mere selection and combination of æsthetical types without an ethical purpose, would be to place it below the level of reason, and to contradict instead of imitate nature. In assigning a purifying effect to art Aristotle spoke truly as a critic and historian, and to denude this purification of an ethical significance would be to lower his authority as a witness, but not to alter the fact. No canon of criticism is more frequently repeated at the present day than that of Aristotle, that art is without ethical end. This criticism, however, is not true to nature. Art cannot cease to be æsthetical in order to be ethical. It must always deal with the perceptive, but within its own province it is subject to its own ethical code, and it has besides affinities with the general ends of ethics which cannot be ignored with impunity. The pleasure it affords must always be pure, and it may also be instructive. Gayley & Scott, 'Guide to the Literature of Æsthetics'; B. Bosanquet, 'History of Æsthetics.'

Aëta. See NEGRITOS.

Æthel, prefix in Anglo-Saxon names. See ETHEL.

Æthelbold. See ETHELBOLD.

Æthelhard. See ADELARD.

Ætheling. See ATHELING.

Æther. See ETHER.

Æthiopis, Greek epic poem in five books by Arctinus of Miletus. Its heroine is Penthesilea, the Amazon queen, and its story is that of the events of the Trojan war which occurred after those narrated in the 'Iliad.'

Æ'thiops Martial, an old pharmaceutical name for black oxid of iron.

Æ'thiops Mineral, a name sometimes given to the artificial black sulphide of mercury.

Æ'thogen, a compound better known as nitride of boron. See NITRIDES.

Æth'rioscope, eth'ri-ō-skōp, a form of differential thermometer devised by Sir John Leslie. Both bulbs of the thermometer are enclosed in a concave mirror, one of them being in its focus. The instrument is so sensitive that when directed toward the sky it is affected by a passing cloud. It is not much used at the present time.

Aëtius, ā-ē'shius, the last great Roman general and savior of western Europe from being Hun: b. Durostorum on the Danube (now Silistria), c. 390 A.D.; murdered toward the end of 454. He was son of a distinguished commander Gaudentius (probably barbarian); in military service while a boy, and given to Alaric as a hostage after Pollentia in 403, remaining three years; later a hostage to the Huns; and gaining close intimacy with both races, of mixed results. After Honorius' death he supported the secretary Joannes against the empress-regent Placidia, and brought an army of 60,000 Huns to his aid; but, Joannes having just been defeated and slain, the Huns were bribed to go home, and Aëtius was made count of Italy and commander of the army, and became the chief adviser and prop of Placidia and her children. His main rival was Boniface, Count of Africa, at Carthage: and the accepted story is that by a base double intrigue he drove him into revolt and calling the Vandals from Spain into Africa; that on discovering the fraud Boniface fought in Italy first a slight battle and then a duel with Aëtius, was mortally wounded, and in dying counseled his wife to marry no one but his rival. It is very suspicious; but any way the Vandals overran North Africa; Boniface was killed; Aëtius in 432 had to flee to the Huns, came back the next year with an army of them, was reinstated, and for the next 17 years was the ruling spirit in the Western Empire, battling in Gaul with Visigoths, Burgundians, and Franks, upholding by combined soldiership and policy the declining state, with a vigor and genius which made him the one great man of the Roman world in foreign eyes. In 450 the great Hunnish invasion under Attila (q.v.) came rolling down into Gaul with a volume it seemed impossible to stay, and the success of which might have blighted western Europe as their kinsmen the Turks have blighted the eastern portion. Aëtius by his diplomatic skill and knowledge of how to play on the barbarians induced Theodoric the Visigoth to league with him, followed Attila into the Seine valley, and on 20 Sept. 451 checked his progress in the mighty battle of Châlons (q.v.); the empire's last victory, and one of the world's turning-points. Attila's death not long after broke up the Hunnish coalition and delivered the empire from it; but it was also Aëtius' death sentence, and with his the empire's. Valentinian III., Placidia's son, hated Aëtius' power and had only submitted to it from fear of Attila; and, feeling now secure, seized the occasion of a visit of Aëtius to Rome, to arrange the marriage of his son with Valentinian's daughter, and stabbed him with his own hand. The sack of Rome by the Vandals shortly followed; and 22 years after Aëtius' murder the last of a succession of puppet emperors was pulled down by the barbarian Odoacer.

Æt'na. See ETNA.

Ætolia, ancient Greece, a district lying along the N. shore of the Gulf of Corinth and having Epirus and Thessaly N., Acarnania W. separated by the Acheloüs, and Locris and Doris E. separated by the Daphnus. The only other river of any size was the Evenus. Between it and the Acheloüs lies a marshy but fertile plain, separated by the Aracynthus range on the north from a similar plain, of which two large communicating lakes — Trichonis (Apokuro) and Hyria (Zygos) — take up a great part. The rest of the country is crossed in all directions by rugged mountains, covered with forests, and intersected by ravines. The plains produced plenty of corn and fine pasture, and the Ætolian horses were famous, while the mountain slopes gave excellent wine and oil; but for some reason the tribes never till late in Greek history entered into the fellowship of Greek civilization, and then but imperfectly. They were wild, backward, anarchic, and untamable; a race of robbers and pirates, and the best recruiting-ground in Greece for mercenary soldiers. In the Heroic age, when most other Greeks were like them, and Odysseus' grandfather won distinction as an accomplished *klepht,* they were conspicuous; and Ætolia was the scene of the Calydonian boar hunt. (See MELEAGER.) When they reappear in Thucydides' pages on the Peloponnesian war, they are a congeries of unfederated independent tribes, living by plunder and the chase, with few and poor towns,— Thermon, Calydon, and Pleuron the chief,— and taking to the mountains when hard pressed. They had a sort of union like the Iroquois League, for common action against a common enemy, but no corporate accountability and nobody to make a treaty with. After Alexander's death Antipater and Craterus invaded the country; and this, with the great new wealth their general trade of soldiering was bringing in and consequent increase of civilized interests, forced them to strengthen the bond into the Ætolian League, first mentioned in 314 B.C., but of immense weight in later times and chief rival to the Achaian League and Macedonia. Unlike the former, it was a league of tribes, not towns. But like that, it was a democracy nominally, every freeman over 30 having a vote if he could come to the capital and cast it, but an aristocracy

or timocracy in practice, only the wealthier being able. There was a Great Council, or Panætolicon, which met yearly at Thermon, elected all magistrates afresh, and enacted general laws and voted on foreign policy; a smaller body of Apocletæ, who were in fact a cabinet, who prepared all questions to put before the Great Council and seem to have been permanent; a chief magistrate, the *strategos* (general), who was not only military commander but president of the assembly, put such questions as he chose (Speaker), was elected annually, and was not allowed a vote on the question of peace or war; a *hipparchos* or cavalry commander; and a chief secretary. After the expulsion of the Gauls from Greece in 279, in which the League did good service, it expanded enormously; not like the Achaian League because of the advantages of its membership, but from the exceeding disadvantages of its hostility — for it never lost its piratical character wholly to its latest day. It took in Locris, Phocis, and Bœotia, Acarnania, southern Thessaly, and Epirus, many cities in the Peloponnesus, Thrace, and Asia Minor, and the island of Cephallenia; it controlled the oracle at Delphi and the Amphictyonic Council. But its wanton invasion of Messenia (S.W. Peloponnesus) in 220 brought the Achaian League and Macedonia both against it: Philip V. invaded Ætolia in 218, sacked Thermon with its vast accumulated national treasures, and burnt the sacred buildings; and the next year they made peace. In 211 they again provoked a war with Macedonia, and again Thermon was captured, peace being made in 205. In 200 they joined Rome against Macedonia, and helped to win the battle of Cynoscephalæ, which crushed Philip; but they were so disgusted with Flamininus' settlement of the country without giving them the advantages they expected, that in 192 they made the fatal error of allying themselves with Antiochus of Syria against the Romans. Antiochus was crushed in 189, and the independence of the League came to an end. In 167 the pro-Roman party murdered 550 of the patriot leaders, and the League was dissolved and Ætolia made a Roman province.

Affection, in psychology, is a mental element co-ordinate with «sensation.» See FEELING.

Affidavit, a statement reduced to writing, and sworn or affirmed to before some officer who has authority to administer an oath. An affidavit should refer to the cause in which it is made. The common-law rule is that it must contain the title of the cause. The place where the affidavit is taken must be stated, to show that it is taken within the officer's jurisdiction. The affiant must sign the affidavit at the end. It is necessary that the officer signing the jurat should append his official title.

An affidavit should also describe the affiant sufficiently to show that he is entitled to offer it, for instance that he is a party, or agent or attorney of a party to the proceeding. This matter must be stated, not by way of recital or as a mere description, but as an allegation in the affidavit.

Affidavit of Defense.— A statement made in proper form that the defendant has a good ground of defense to the plaintiff's action upon the merits.

Affidavit to Hold to Bail.— An affidavit which is required in many cases before a person can be arrested.

Affiliation is a species of adoption which exists in some portions of France and in other European States. The person affiliated succeeds equally with other heirs to the property acquired by the deceased to whom he had been affiliated, but not to that which he inherited. See ADOPTION.

As to orders of affiliation in bastardy proceedings, see BASTARD.

Affine Transformation, a-fīn', in geometry, a transformation by means of which every point in a plane receives a displacement whose direction is parallel to a given fixed straight line called the axis of affinity, and whose magnitude is proportional to the distance of the given point from that axis. The affine transformation is projective; that is, it transforms every straight line into a straight line.

Affinity. In law, the connection existing in consequence of marriage between each of the married persons and the kindred of the other. By the marriage one party thereto holds by affinity the same relation to the kindred of the other that the latter holds by consanguinity; and no rule is known to us under which the relation by affinity is lost on a dissolution of the marriage more than that by blood is lost by the death of those through whom it is derived.

Affinity is distinguished from consanguinity, which denotes relationship by blood. The degrees of affinity are computed in the same way as those of consanguinity.

In Chemistry.— The tendency manifested by certain substances to unite with one another so as to produce new combinations, chemically different from the primitive ones. The word was originally applied in this sense in the belief that some obscure and undiscovered «affinity» or relationship existed between the combining substances; but it now appears probable that the contrary is more nearly true, and that the tendency toward combination is strongest, generally speaking, between bodies that are quite dissimilar; though it is impossible to lay down any fixed rule of this simple kind. The modern theory of chemical affinity is too elaborate to be treated adequately under a single heading. See CHEMICAL AFFINITY; DISSOCIATION; ELECTROLYSIS; EQUILIBRIUM (CHEMICAL); MOLECULAR THEORY; SOLUTION.

Affirmation, the act of affirming, in the sense of solemnly declaring in a court of law that certain testimony about to be given is true. Also, the statement made. First the Quakers and Moravians, who objected on conscientious grounds to take oaths, were allowed to make solemn affirmations instead; now everyone objecting to take an oath has the same privilege; but, as is just, false affirmations, no less than false oaths, are liable to the penalties of perjury.

Affre, Denis Auguste, afr', dė-nē ō-güst, French ecclesiastic: b. 27 Sept. 1793; d. 27 June 1848. From his prudent and temperate character he was made Archbishop of Paris by Louis Philippe's government in 1840. Though not yielding blind submission to all its measures, he abstained from offensive opposition; and when a republic was proclaimed in 1848 he kept aloof from political strife, but displayed earnest

zeal for the public welfare. During the June insurrection he climbed on a barricade in the Place de la Bastille, carrying a green bough in his hand, as a messenger of peace; but he had scarcely uttered a few words when the firing recommenced, and he fell mortally wounded, to die next day. He wrote several theological works and one on Egyptian hieroglyphics.

Afghanistan, «Afghan-land,» Asia, a country lying between Persia W. and India and its N.W. frontier tribes E., with the latter and Baluchistan S., and Russia, Bokhara, and the Pamir region N.; extending from lat. 29° to 38° 30′ N. and lon. 61° to 75° E. Area, as defined N. 1885 and S. 1893, about 215,000 sq. m.; length E. to W. about 560 m., breadth about 450. Pop. estimated toward 5,000,000. The chief political divisions are Afghan Turkestan, Kafiristan, and Badakhshan, with part of the Pamirs turned over to it by the other powers: Kabulistan, of which Kabul is the heart, and including Ghazni and Jalalabad; and Herat. There are also independent khanates, and wild tribes which belong to nothing but the semi-enforceable sway of the amir.

Topography.— Afghanistan consists chiefly of lofty, bare, uninhabited table-lands, ranges of snow-covered mountains, and deep ravines and valleys. Many of the last are well watered and very fertile, but about four fifths of the whole surface is rocky, mountainous, and unproductive. The surface on the N.E. is covered with the lofty ranges of the Hindu-Kush, often 18,000 and sometimes exceeding 20,000 ft. high; the loftiest passes are above 12,000 ft.; and the road often passes along the base of mural precipices rising from 2,000 to 3,000 ft. It is an offshoot of the Himâlaya, parting the Oxus basin from the Afghan basins of the Kabul and Helmand; and sweeping S.W., at about lon. 68° (the Irak and Shibar passes) is prolonged by the Koh-i-Bâbâ, which breaks into several almost parallel branches inclosing the valleys of the Heri-Rud (Herat River) and Murghâb (Merv River), the two main ones known as Safed-Koh («white mountain»; there is another of the same name in the Kabul basin) and Siah-Koh. The E. is traversed by the Suleiman Mts., which extend to the Indus, and are united by a range called the Paghman Mts. with the Hindu-Kush above the Sirak Pass. The principal avenues of communication between Afghanistan and India are the famous Khyber (Khaibar) Pass, by which the Kabul River enters the Punjab; the Gumul Pass, also leading to the Punjab; and the Bolan Pass to the S., through which the route passes to Sind. Of the rivers, mostly in the centre of the country, the largest is the Helmand (old Etymander), which rises in the Koh-i-Bâbâ and Paghman Mts. between Kabul and Bamian, flows S.W. more than 400 m., till it enters the great Hamun or Seistan swamp; previous to which, however, its water is almost all drawn off for irrigation canals. About 45 m. below Girishk it receives the Arghand-âb, of about 235 m., rising in the Ghilzai country N.W. of Ghazni, and flowing past Kandahar. Next in importance are the Kabul in the N.E., an affluent of the Indus; and the Heri-Rud or Hari-Rud in the N.W., draining the Herat valley. The Amu-Daria or Oxus separates Afghanistan from Bokhara. The only lake worth mentioning (the Hamun being almost entirely in Persia) is the Ab-i-Stada, a shallow sheet about 12 m. in diameter, about 100 m. S.W. of Ghazni, at an elevation of some 7,000 ft.

Climate and Natural Products.— The climate is intensely hot in the lower regions and extremely cold in the upper, but fairly salubrious. The rainfall even in the rainy season is slight, and agriculture is maintained by irrigation canals, including a system called *karez,*— underground channels connecting the springs. The N. mountains are forested to about 10,000 feet; the others are bare. The commonest trees are pine, oak, wild olive, cypress, birch, walnut, and holly. Many indigo-yielding plants grow spontaneously on offsets of the Hindu-Kush, and asafœtida, a resinous gum, is an important product. In the plains the mulberry, tamarisk, acacia, willow, plane, poplar, and date palm, are found; and fine fruits in the greatest variety and abundance — especially apples, pomegranates, and peaches — grow wild. Wild animals are tigers, bears, leopards, wolves, jackals, hyenas, foxes, gazelles, wild asses, etc.

Agriculture, Manufactures, and Trade.— The cultivable soil in the valleys, a very small proportion of the whole area, is highly fertile under irrigation, but it is ill managed. In many parts two harvests are reaped annually: rice, corn, and millet occupying the land from spring to fall, wheat and barley, beans and peas thence to spring. The staple food of the people is wheat, that of cattle, barley. Other crops are grapes, tobacco, madder, and cotton, with some sugar-cane. Domestic animals are extensively bred: the chief are the horse, ass, and mule, the ox, sheep with large fine fleeces and enormous fat tails (famous in the «cinnamon stew»), the camel and dromedary. Manufactures are very scant, though some rugs, silks, sheepskins, camel- and goat-hair fabrics, etc., are sold; but the export of raw material is large, and forms a great trade with India and a considerable one with Bokhara, employing some 25,000 camels and many ponies, the use of wheeled vehicles being mostly impossible. The chief articles are wool (mostly sent to Karachi), raw silk, horses, dried fruits, madder, and asafœtida; rugs, silk goods, and rosaries also go out. The mineral deposits include all the great valuable kinds, but political conditions forbid their exploitation; some iron, lead, and sulphur are worked, however. Precious stones are found in the mountain country around Badakhshan.

Chief Towns.— The four leading places of Afghanistan are Kabul the capital, in the east, not far from the Indian border at the famous Khyber Pass, with some 70,000 people; Kandahar southwest of it, with 25,000, and Ghazni of 10,000 between them, all three on a great highroad that runs to Baluchistan, and forming a southeastern line of trade; and Herat of 30,000, in the extreme northwest, close to Persia. In Afghan Turkestan the chief place is Balkh; others are Andkhui, Akcha, Kunduz, Maimene, Tashkurgan, etc.

Peoples.— The Afghans proper, or Pathans, as the English call them, are the dominant race, forming perhaps three fifths of the whole. «Afghans» is the Persian name, their own being Pushtaneh or Pukhtaneh, and their language Pushtu or Pukhtu. The latter is Indo-European, and they are at bottom of that stock, though heavily mixed with the natives they

found there on invading the country (certainly centuries before Christ, as the Greeks found them there in the 4th); they claim Jewish descent, but this results from their Mohammedan religion (they are Sunnites), and occasional resemblances of feature, as they are not Semites. They are a finely built race, hardy, fierce, and turbulent, whose preference is plunder to live and fighting to enjoy. They force the inferior races to do the labor, and the land is cankered with blood-feuds. They are divided into many tribes, of whom the strongest are the Ghilzais of the east, and next the Duranis of the west and south (including the present amir and his predecessors of Dost Mohammed's family); strong also are the Yusufzais and Afridis on the borders of India. Among the others are the Swatis, Waziris, Kakars, and Kostis. There are also races of non-Afghan blood in Afghanistan: the Hazaras, a Mongol race living chiefly in the northwest; the Jats and Aimaks, Mongol; the Tajiks, believed to be a remnant of the aboriginal population and akin to the Dravidians of India; the Hindkis, an Indian race living in the southwest; the Kizilbashes, Persianized Turks; etc.

Government and Society.— There is a fair code of laws: from the nature of Afghan society the real law is that of the strongest, tempered by the responsibility of governors not to let society dissolve altogether from absence of justice. The ruler is a hereditary absolute monarch called the Amir, whose power among so fierce a feudal Oriental aristocracy is what he can enforce, which is very little unless he is a man of great abilities and firmness like the late Abd-ur-Rahman. Says a recent writer, « Like most monarchs, he rules not as he will but as he can, and the mantle of his authority covers the most turbulent race under the sun.» This is so even among the accessible peoples with a relatively civilized development of society: while there are many outlying tribes and chiefs who do not acknowledge his power, and can only be coerced into an appearance of submission by military force, as those of Kafiristan which Abd-ur-Rahman had but lately cowed at his death. These tribes furthermore are fanatical Mohammedans, which is always a fighting religion. Those which border on India, as the Afridis (whose position at the Khyber Pass, which must be kept open for a clear road to Kabul, makes it needful to hold them in with a strong hand), are counted as under British control rather than that of the amir, who besides receives an annual subsidy of 1,800,000 rupees (formerly 1,200,000), or about $630,000, from the Indian government, to enable him to maintain an efficient army and good order. Every eighth man is nominally subject to draft for military service; but the actual army is about 60,000, the detachments around Kabul, Kandahar, and Herat, and in Afghan Turkestan, numbering 37,000 foot and 7,000 horse, with 360 guns. At Kabul is an arsenal, also an ammunition factory and a mint having English machinery and supervision. The revenue is from tithes on produce, and naturally varies with the harvests. The money of account is the rupee (about 35 cents). Education is conducted by Mohammedan schools: of its nature a not unfair description may be found in Count Gobineau's 'History of Gamber-Ali,' in his 'Nouvelles Asiatiques' (Englished as 'Romances of the East').

History.— The first invasion of Indo-Europeans is before history. The country was subjugated after a fashion by Alexander the Great, who founded Herat (as Alexandria Arion), most likely Kandahar, and either Kabul or a colony near it. The Seleucid empire had no actual hold over it; the Romans lost even its nominal control to the Parthians and the later Persian empire; and the Saracens took it after their conquest of Persia. With the break-up of the Bagdad caliphate the Samanide dynasty possessed it, till overthrown in turn by the Ghaznevide, who held it till their downfall in 1183. Jenghiz Khan conquered it in the middle of the 12th century, and Timur late in the 14th; in 1504 Baber or Babar, the founder of the « Mogul » dynasty in India, had Kabul for his first capital, and Afghanistan became part of the great Afghan-Hindu empire, and remained a part of it while the Mogul dynasty kept its strength. In 1722 the Afghans raided Persia under one Mahmud, and permanently crippled Ispahan, which they captured; but in 1738 Nadir Kuli of Persia, later Nadir Shah (q.v.), retaliated and conquered Afghanistan. In 1747 he was murdered; Ahmed Shah, one of his generals, obtained the sovereignty of Afghanistan, and became the founder of the Durani, the first Afghan dynasty, which lasted about 80 years. At the end of that time Herat was all that remained in the hands of a Durani sovereign, while Dost Mohammed Khan, the ruler of Kabul, had acquired a preponderating influence in the country. He was desirous of gaining the assistance of the British against Persia; but believing that he was meditating treachery against them they resolved to dethrone him and restore Shah Shuja, a former ruler. In April 1839 a British army under Sir John Keane entered Afghanistan, and after overcoming some slight resistance entered Kabul and placed Shah Shuja on the throne. A force of 8,000 was left to support the new sovereign, and the rest of the army returned to India. Sir W. Macnaghten remained as envoy at Kabul, with Sir Alexander Burnes as assistant envoy. The Afghans were by no means content with the new state of affairs, however. A widespread conspiracy was organized, which came to a head on 2 Nov. 1841, when Burnes, Macnaghten, and a number of British officers, besides women and children, were murdered. The other British leaders were disheartened and paralyzed, and a treaty was made with the Afghans,— at whose head was Akbar, son of Dost Mohammed,— by which the former agreed to withdraw the forces from the country, while the latter were to furnish them with provisions and escort them on their way to Jalalabad. On 6 Jan. 1842, the British left Kabul and began their disastrous retreat. The cold was intense, they had almost no food — for the treacherous Afghans did not fulfil their promises — and day after day they were assailed by bodies of the enemy. By the 13th, 26,000 persons, among whom were many camp-followers, women and children, were destroyed. Some were preserved as prisoners, but only one man, Dr. Brydon, reached Jalalabad with the dismal news.

Jalalabad, in which Gen. Sale was stationed with a small force, was soon after besieged by


PERSIA
AFGHANISTAN
AND BALUCHISTAN
SCALE OF MILES.
0 50 100 150 200 250 300
Population of places is indicated
by different lettering, thus:
100,000 and over TEHERAN
50,000 to 100,000 Kandahar
25,000 to 50,000 Meshed
10,000 to 25,000 Ardistan
Smaller Places
Railroads
Copyright, 1904, by The Americana Company.
RUSSIAN EMPIRE
TURKESTAN
CHINESE EMPIRE
CASPIAN SEA
PERSIA
AFGHANISTAN
BALUCHISTAN
ARABIA
TURKEY
PERSIAN GULF
GULF OF OMAN
ARABIAN SEA
OMAN
KHORASAN
KERMAN
IRAK ADJEMI
FARSISTAN
KURDISTAN
LURISTAN
KHUZISTAN
MAZANDARAN
ASTERABAD
TEHERAN
TABRIZ
BOKHARA
Samarkand
Khokand
Taschkent
Herat
Kandahar
Kabul
Peshawar
Rawalpindi
LAHORE
AMRITSAR
Multan
Haidarabad
KARACHI
Bikaner
Jodhpur
Ispahan
Yesd
Kerman
Shiraz
BAKU
Tiflis
Kara Kum
Hindu Kusch
Plateau of Sarhad
Longitude East from Greenwich

Akbar; but on the approach of Gen. Pollock, who had forced his way through the Khyber Pass with a fresh army from India, the Afghan forces withdrew. After joining his forces with those of Gen. Nott, who had meanwhile maintained himself in Kandahar and had taken Ghazni, Gen. Pollock entered Kabul and soon finished the war, though not without some hard fighting. Dost Mohammed again obtained the throne of Kabul and acquired extensive power in Afghanistan. He joined with the Sikhs against the British; but in 1855 he made an offensive and defensive alliance with the latter, which he renewed in 1857. He died in 1863, having nominated his son Shere Ali his successor. He entered into friendly relations with the British, and this state of matters continued till 1878; when, the amir having repulsed a British envoy and refused to receive a British mission (a Russian mission being meantime at his court) war was declared against him, and the British troops entered Afghanistan (November 1878). They met with comparatively little resistance; the amir fled to Turkestan, where he soon after died; and his son Yakub Khan, having succeeded him, concluded a treaty with the British (at Gandamak, May 1879), in which a certain extension of the British frontier, the control by Great Britain of the foreign policy of Afghanistan, and the residence of a British envoy in Kabul, were the chief stipulations.

Not long after this settlement, however, the British resident at Kabul, Sir Louis P. Cavagnari, and the other members of the mission, were treacherously attacked and slain by the Afghans, and troops had again to be sent into the country. Kabul was again occupied, and Kandahar and Ghazni were also taken; while Yakub Khan was sent to imprisonment in India. In 1880 Abd-ur-Rahman, a grandson of Dost Mohammed, was recognized by Great Britain as amir of the country. The occupation of Merv by Russia in 1881, and the subsequent continuous pushing forward of the Cossack outposts toward Herat and the south, now began to be seriously considered by the British as menacing India. After some negotiations between the two governments it was arranged that an Anglo-Russian commission should be constituted to settle the frontier between Afghanistan and Russian territory. In the meantime, however, the Russian troops were advancing; and in 1885 they reached Penjdeh, where they came into conflict with a body of Afghans. For a time war seemed imminent between Great Britain and Russia; but it was at last settled that the boundary line extending from the Heri Rud to the Oxus should run so as to exclude Penjdeh, but include Meruchak in Afghanistan, following the Oxus east from about Khojah Saleh to Lake Victoria, north of Chitral. The boundary between Afghanistan and British India was long uncertain; but in 1893 an arrangement was come to between the amir and Sir Mortimer Durand. The boundary then agreed on was demarcated shortly afterward and is so drawn as to leave Chitral, Bajaur, Swat, Chilas, and Waziristan to Great Britain, while Afghanistan is given the territories of Asmar, Birmal, and Kafiristan. The Amir's annual subsidy was also increased from 12 to 18 lacs of rupees, and restrictions on the import of arms, etc., were removed. Abd-ur-Rahman proved himself a vigorous ruler and the steady friend of Great Britain, and did much under the guidance of Englishmen to civilize his subjects and develop the resources of his country. He was for a time suspected of secretly assisting the frontier tribes in their revolt in 1897; but he later gave unmistakable proof of his loyalty. He died in Kabul, 3 Oct. 1901, and his eldest son Habibullah-Khan succeeded him.

A Fortiori, an argument derived from what is stronger; an argument more potent than that which has just before been employed. When in Euclid it is reasoned, for example, that much more then is the angle B D C greater than the angle B C D, the use of the words much more implies that the *à fortiori* argument is used.

Africa, third in size of the five continents, with a continental area of 11,500,000 sq. m. and islands of 239,000 more, has the Mediterranean N., the Atlantic W., the Red Sea and Indian Ocean E., the Antarctic Ocean S.; and lies nearly due S. of Europe and S.W. of Asia. It extends from lat. 37° 20′ N. to 34° 51′ S., and lon. 17° 32′ W. to 51° 16′ E., being nearly equal in length and breadth from its extreme points: from Cape Blanco in Tunis to Cape Agulhas in Cape Colony is nearly 5,000 m.; from Cape Verde in Senegal to Cape Guardafui in Somaliland about 4,600. The N. section, however, has an average breadth nearly double that of the S., owing to the great N. projection of the upper part, the W. coast taking a sudden inward turn and facing S. for nearly 20° of longitude, forming the Gulf of Guinea, its greatest indentation.

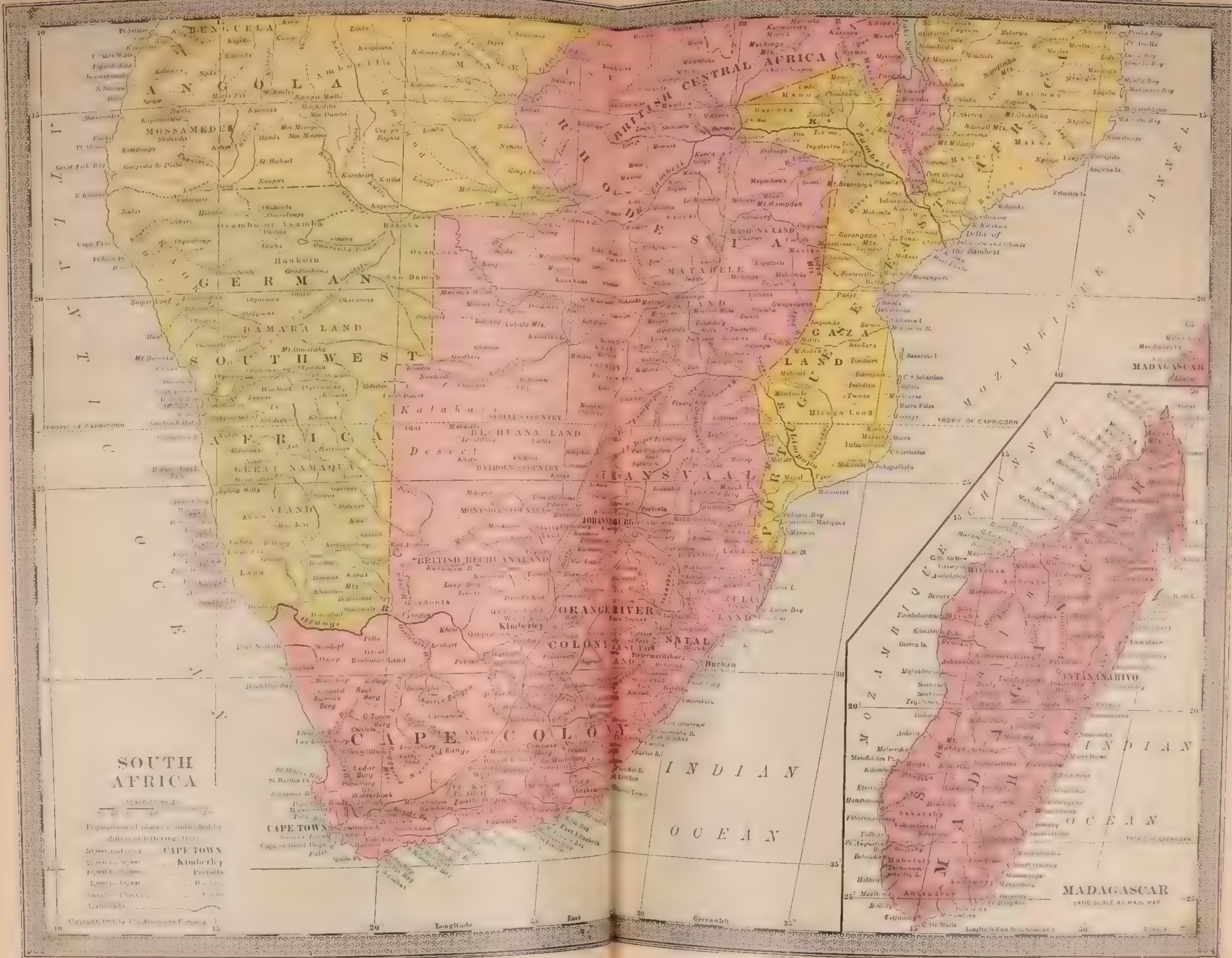
General Topography.— From its junction with Asia at the Isthmus of Suez, the N. coast runs W. by a little N. to the Strait of Gibraltar; its nearest approach to Europe, whose Mediterranean shore it faces, and whence for many centuries it derived its principal civilization. The chief indentation is that forming the Gulfs of Cabes and Sidra. From the Isthmus S. the coast runs somewhat S.E. parallel to Arabia, separated by the long narrow expanse of the Red Sea; further S. it projects well to the E., overlapping the S. coast of Arabia and again running nearly parallel to it, the two forming the Strait of Bab-el-Mandeb and the Gulf of Aden. From the terminus of this projection at Cape Guardafui, the coast trends S.W. with slight undulations to the S. extremity of the continent. About midway, separated from the mainland by the Mozambique Channel, 250 m. wide, lies the great island of Madagascar. Save those named, Africa has no great indentations, and the coast line is very small relatively to its size: about 16,000 m., a fifth less than that of Europe absolutely, and between one fourth and one fifth as great relatively. The S. extremity presents to the Southern Ocean a coast line of nearly 400 m. excluding indentations, compendiously known as «the Cape,» first doubled by Bartholomew Diaz and Vasco da Gama. Its principal indentations are Algoa Bay and False Bay. The islands belonging to Africa are not numerous, and except Madagascar none of them large. In the Atlantic Ocean there are Madeira, the Canaries, the Cape Verde Islands, the Bissagos, the islands off the coast of Guinea, Fernando Po, St. Thomas, Annobon, etc., Ascen-

sion Island, St. Helena, and Tristan d'Acunha; in the Indian Ocean, Sokotra, Zanzibar, Comoro Isles, Madagascar, Mauritius, Réunion, with their dependencies; and some small islands in the Southern Ocean.

Northern Africa.— The interior of Africa forms two great divisions nearly corresponding with the external diversity of form already indicated. The N. section has its greatest extension from E. to W., the S. from N. to S. The N. division lies for the most part above the sixth degree of N. latitude, extending from the Atlantic on the W. to the Somali coast and the Red Sea on the E. Its principal feature is the Sahara or Great Desert, which is inclosed on the N. by the elevated plateau of Barbary and that of Barca, on the E. by the Nile valley, on the W. by the Atlantic Ocean, and on the S. by the Niger and the countries of the Sudan. The N. coast region (plateau of Barbary) is traversed by the Atlas system and its continuations, rising to the height of 13,000 ft. or even more. Exclusive of the mountains it has an elevation of from 1,500 to 3,000 ft. From Barca, where the former level prevails, it descends gradually toward Egypt. The character of the desert, though sufficiently inhospitable, is much less uniformly monotonous than till recent researches it was commonly reputed to be. Instead of an undeviating sandy plain irregularly interspersed with speck-like oases it contains elevated plateaux and even mountains with more or less permanent streams, and habitable valleys which lose themselves in the vast low-lying tracts of sand with which the more elevated regions alternate. The desert itself is furrowed with *wadis* (dry river-beds) radiating in all directions; while under the sand collections of water have been found, which by means of artesian wells have been turned to account by the French in their dependency Algeria. A considerable nomadic population is thinly scattered over the habitable parts of the desert, and in the more favored regions there are settled communities. (See SAHARA.) To the S. of the Sahara, and separating it from the plateau of southern Africa, a belt of pastoral or steppe country extends across Africa. This region has received the general name of the Sudan, and includes the countries on the Niger, around Lake Tchad, and E. to the elevated region of Abyssinia.

Southern Africa.— From Lake Tchad the country begins to rise till below the 10th degree of N. latitude, where the edge of the elevated plateau of high or southern Africa begins. This division of the continent is, as far as known, completely surrounded, at a distance of 50 to 300 miles from the coast (which is usually low but rising inland), by what look like ranges of mountains varying in breadth and height; but which are really the escarpment of a table-land, or series of table-lands, of considerable elevation and great diversity of surface and direction, having hollows filled with great lakes rivaling those of America in extent, and terraces over which the rivers break themselves in falls and rapids. The S. division has, like the N., a desert region — the Kalahari desert — but it is of small extent compared to the Sahara. In some respects it resembles the Sahara, but possesses more vegetation. The mountains which inclose the S. table-land are mostly much higher on the E. than on the W.; and the slope of the land and the flow of the principal rivers, with the exception of the Zambesi, is from E. to W. The E. edge of the plateau reaches its highest elevation and greatest extent in the mountainous country of Abyssinia, with heights of 10,000 to 14,000 or 16,000 ft. From this the system extends N. in detached ranges or occasional elevations between the valley of the Nile and the Red Sea, with gradually diminishing height to the very delta of the Nile. The E. edge of the Abyssinian plateau presents a steep unbroken line of 7,000 ft. in height for several hundred miles. This line of elevation extends S. toward Lakes Rudolf and Stefanie, and thence in a narrow belt and at a lower average level to the N.E. of the Victoria Nyanza; it then proceeds in a S. direction to Kilima-Njaro, beyond which the plateau merges into the Paré Mts. in the neighborhood of the Pangani River. Immediately to the S. of Lake Rudolf, Mount Nyiro rises to a height of 10,000 ft.; Mount Elgon, to the N.E. of Victoria Nyanza, 14,100 ft.; Mount Kenia, 18,370 ft.; Kilima-Njaro, 19,600 ft.; Mount Meru, to the W. of Kilima-Njaro, 14,000 ft. The general level of the plateau between Mount Kenia and the lake is from 5,000 to 7,000 ft. To the W. of Victoria Nyanza, between Lakes Albert and Albert Edward, Mount Ruwenzori rises to a height of 18,000 ft., and the active volcanic Kirunga Mts., S. of Lake Albert Edward, to 13,000 ft. All these mountains are volcanic in origin, and between Kilima-Njaro and the lake signs of volcanic activity are still visible. The central plateau reaches its greatest average height, over 4,000 ft., in the region embracing the Lakes Victoria, Tanganyika, and Nyassa; it forms a broad belt reaching close to the E. coast, and in an equally broad belt extends from Lake Nyassa to the W. coast. Above this are numerous detached heights, like the Rubeho Mts., W. of Zanzibar, the Livingstone Mts. around the N. of Lake Nyassa, and the Mlanje heights S. of that lake; Mount Mlanje being 9,680 ft. S. of the Zambesi occur the Mashona and Matoppo highlands, rising in places to from 5,000 to 7,000 ft. Immediately to the S. of the Middle Limpopo a series of mountains begins which, under various names — Zoutpansberg, Libombo, Drakensberg, Compassberg, Schneeberg, etc.— extends along the E. and S. coast, and N. to some distance beyond Cape Town. In Natal these rise to 10,000 and 12,000 ft., and in Cape Colony to 7,000 and 8,000 ft.; the interior plateau averaging about 4,000 ft., but falling to a lower level in the Kalahari desert. Between the Orange River and the Kunene, and the latter river and the Kongo, the escarpment continues, rising in places to 6,000 and 8,000 ft. The general level lowers considerably as the Kongo is reached. The low coast region extends some distance into the interior along this part of the W. coast, the descent from the interior plateau giving rise to the cataracts which so seriously interrupt navigation on the lower Kongo. On both sides of the middle Kongo extends a considerable area which sinks from the generally high level of the interior to an average of only about 1,000 ft. From the Kongo and Kameruns the general level of the coast plateau is broken by the Crystal and other mountains rising to 3,000 and 4,000 ft., culminating in the Kameruns Peak, a volcanic mountain rising to 13,000 ft.


AFRICA
SCALE OF MILES.
Population of places is indicated by different lettering, thus;
200,000 and over — CAIRO
100,000 to 200,000 — Fez
60,000 to 100,000 — Cape Town
10,000 to 60,000 — Durban
Smaller towns
Railroads
English
French
German
Spanish
Italian
Portuguese
Independent
ATLANTIC OCEAN
MEDITERRANEAN SEA
ASIA
ARABIA
SAHARA
SUDAN
MOROCCO
ALGERIA
TRIPOLI
EGYPT
SENEGAL
FRENCH GUINEA
LIBERIA
GOLD COAST COLONY
CONGO STATE
GERMAN EAST AFRICA
BRITISH EAST AFRICA
BRITISH CENTRAL AFRICA
BRITISH SOMALILAND
ITALIAN SOMALILAND
ANGOLA
TRANSVAAL
CAPE COLONY
MOZAMBIQUE CHANNEL
INDIAN OCEAN
GULF OF GUINEA
Persian Gulf
Libyan Desert
TROPIC OF CANCER
TROPIC OF CAPRICORN
CAIRO
ALEXANDRIA
Aleppo
Damascus
Beirut
Jerusalem
Athens
Smyrna
Algiers
Oran
Fez
Kano
Timbuktu
Johannesburg
Canary Islands
Ascension
St Helena
Longitude West from Greenwich
Longitude East from Greenwich
Copyright, 190?, by The Americana Company


SOUTH AFRICA
ANGOLA
BENGUELA
MOSSAMEDES
BRITISH CENTRAL AFRICA
RHODESIA
MASHONA LAND
MATABELE LAND
GERMAN SOUTHWEST AFRICA
DAMARA LAND
GREAT NAMAQUA LAND
BECHUANA LAND
Kalahari Desert
BRITISH BECHUANALAND
TRANSVAAL
JOHANNESBURG
Pretoria
ORANGE RIVER COLONY
Kimberley
NATAL
Durban
ZULU LAND
BASUTO LAND
CAPE COLONY
CAPE TOWN
GAZA LAND
PORTUGUESE
MOZAMBIQUE CHANNEL
INDIAN OCEAN
TROPIC OF CAPRICORN
MADAGASCAR
ANTANANARIVO
MADAGASCAR
SAME SCALE AS MAIN MAP
Longitude
East
Greenwich

On the S. of the Benue, in the Atlantika group, and between the Benue and the Niger, we find a broken mountain group with heights of from 6,000 to 10,000 ft.; while in the interior N. of the Gulf of Guinea there is a broad plateau, beginning at various distances from the coast, extending across the upper Niger, and rising to 2,000 and 3,000 ft., with irregular ranges rising at places to from 5,000 to 7,000 ft. The Kong Mts., in the region where the Niger has its sources, as a range do not exist. As the middle Niger is approached the general level lowers to that of the Sahara, while N. the low coast region extends far into the interior till the Atlas is reached.

Rivers.— The Nile is the only great river of Africa which flows to the Mediterranean. It is now known to receive its waters primarily from the country drained by the great lakes, the Victoria Nyanza, the Albert Nyanza, and the Albert Edward Nyanza, and especially from the Victoria Nyanza, which itself receives numerous streams. The Victoria Nile connects the Victoria and the Albert Nyanza; and on leaving the latter the river flows in a winding course, of which the direction is almost due N., without further lake expansion, to the Mediterranean. In descending from the lake elevations (of the Victoria 3,900, of the Albert Edward 3,200 ft., the latter connected by the Semliki River with the Albert 2,300 ft.) it makes, both between the lakes and in its subsequent course, numerous falls. Those in upper Egypt are known as the Cataracts. Between lat. 5° and 10° N., under the name of Bahr-el-Jebel, it receives numerous tributaries, mostly from the country to the S. and W.; the principal on the left bank being the Bahr-el-Ghazal, on the right the Sobat. After this it takes the name of the White Nile, and receives through the Bahr-el-Azrek and Atbara, or Blue Nile and Black River, the drainage of Abyssinia. The Atbara brings the mud which forms so precious a deposit in Egypt. After this the Nile flows for 1,200 m. to the sea without receiving a tributary. Altogether it drains an area of more than 1,000,000 sq. m. The Indian Ocean receives numerous African rivers, most of which are short, being the drainage merely of the external slopes of the escarpment of the interior plateau. Among the most considerable rivers on this coast are the Jub, which is formed by several streams rising in the border slopes near Abyssinia, is navigable with difficulty to Bardera, and enters the ocean at the equator; the Webi Shebeli, formed by streams rising on the S.E. slopes of Abyssinia, and losing itself in the sands on the coast near the mouth of the Jub; the Tana from Mount Kenia discharging at Witu; the Sabaki S. of the Tana; the Rufiji or Lufiji; the Rovuma, which flows from the mountains E. of Lake Nyassa; the Beira; and the Limpopo or Crocodile, which enters the ocean N. of Delagoa Bay. The only great river flowing from a distant point of the interior which breaks the mountain barrier of the E. is the Zambezi, which has its embouchure between the Beira and Rovuma. It is the fourth in size of the continent. It drains a large part of the great tract of pastoral country S. of the equatorial region. Several streams coming from the swampy plateau on the borders of Lunda and the Garenganze country unite to form the Zambezi, the principal being the Liba from the S.W. edge of the Garenganze country. In its middle course it is joined by the Kafue and Loangwe from the N. and the Shire from Lake Nyassa, and by the Chobe and some smaller streams from the S. Below the Chobe are the Victoria Falls, one of the greatest cataracts in the world; from which the river flows in a semicircular course to the ocean, breaking through the Lupata Mts., and discharging by several mouths, the most navigable of which is the Chinde. The river is navigable by vessels of some size to the Karoabassa Rapids beyond the Shire, but above that only by boats and canoes. The drainage area of the Zambezi is 514,000 sq. m.

Of the Atlantic rivers, the Senegal, Gambia, and Niger have their origin in the mountains near the coast of Senegambia. The Senegal flows in a N. and W. direction, its volume varying much according to the season. In the rainy season it is navigable for 500 to 700 m., in the dry season for about a fourth of that distance. The Gambia takes a winding course to the W., and is navigable for about 400 m., nearly its whole extent. The greatest of these rivers, the Niger, rising in the inner slope of the same mountains, flows N.E. to Timbuktu, whence it turns first E. and afterward S.E., receiving the Sokoto, to its junction with the Benue, which comes from the mountains S. of Lake Tchad. The upper part of the Niger is called the Joliba, and is flanked by several great swampy lakes; it afterward acquires the name of Quorra or Kawarra. In the N. part of its course it touches on the great desert. It is navigable for light vessels above Timbuktu. Between the Sokoto and the Benue it is interrupted by shoals and rocks to below Boussa. From the junction it flows due S. to the ocean, where it forms a wide alluvial delta, and enters by a number of mouths, the most distant of which are 200 m. apart. The main channel is called the Nun. The drainage area of the Niger is 810,000 sq. m. The Kongo, the second in extent of basin and the greatest in volume of the African rivers, flows from different slopes of the same watersheds as the Zambezi. Its identification with the Lualaba, the great stream discovered by Livingstone in the centre of the continent, was established by Stanley in 1876–7, this enterprising traveler having descended the river to the Atlantic from a point in the interior W. of Tanganyika. The Lukuga, the outlet of Lake Tanganyika, discovered by Cameron, is a tributary of the Lualaba. The Chambeze, which rises in the mountains between Lakes Nyassa and Tanganyika, is the remotest source of the Kongo system. It falls into Lake Bangweolo, from which it issues under the name Luapula, and flows N. to Lake Mweru; from the N. side of this lake issues the Lualaba, which passes through a magnificent series of lake-like expansions and receives numerous tributaries. Below Stanley Falls it receives the Lomami, and above Stanley Pool the Kwa, which is formed by the junction of the Kasai-Sankuru system with the Lukuallu or Kwango. Other tributaries come from the S., and in the N. it is fed by the Ubangi, which, under the name of the Wellé-Makua, comes from the water-parting between the Nile and Kongo systems. The total length of the Kongo is about 3,000 m., and its drainage area 1,450,000 sq. m. Unlike most of the African

rivers, the mouth of the Kongo forms an estuary. It is estimated to pour into the ocean a larger body of water than the Mississippi. The Kwanza rises in the Mossamba Mts., and curves N.W. to the ocean. Like most African rivers, its upper course is interrupted by cataracts, and its mouth closed by a bar. The Kunene rises on the opposite side of the same watershed, and flows S.W. to the Atlantic. From it S. to the Orange River follows a dry belt, through which no considerable river flows to the sea. The Orange, though it rises near the E. coast, and flows nearly across the S. part of the continent, passes for the greater part of its course through a desert region, receiving no tributaries, and is a shallow stream. Its headwaters, the Vaal and the Nu Gariep, rise on opposite slopes of the Drakenberg Mts., and flow to their junction round opposite sides of the Orange River Colony. The Great Fish River, which drains Great Namaqualand, enters the Orange River near the termination of its course.

The rivers which reach the ocean do not account for the whole drainage of Africa. There are two great and numerous smaller tracts from which no large river reaches the sea. The two great areas of internal drainage correspond with the two great deserts. That of the N. desert is estimated at 4,000,000 sq. m. As already indicated, it is furrowed with water-courses in every direction, which lose themselves in the sand. The Bahr-el-Ghazal, which is usually dry, but intermittently flows out of Lake Tchad, terminates in a salt lagoon on the border of the desert to the N. of the lake. In the S. the Zuga or Botletle, which forms the outlet of Lake Ngami, in the Kalahari desert, loses itself in salt lagoons at greater or less distance, according to the supply of water. A region of inland drainage, with salt lagoons, also exists between the Victoria Nyanza and the coast range of mountains. In the low coast land E. of Abyssinia the Hawash River loses itself in the sands before reaching the sea; and the Webi, as already stated, which flows S. from the Somali Peninsula to near the equator, likewise terminates in a salt lagoon on the border of the ocean. The Omo flows into the N. end of Lake Rudolf.

Lakes.— The only lake of considerable extent N. of lat. 5° N. is Lake Tchad, an enormous flooded swamp. Lake Tana in Central Abyssinia, the salt Lake Asal in the E., and Lakes Dembel and Abayo in Gallaland, are comparatively small. Between 5° N. and 15° S. is a series of lakes forming one of the most striking features of the continent. Almost in a line, beginning in the S., are Lakes Nyassa, Tanganyika, Lifu, Albert Edward, Albert, all lying in more or less elongated rifts or gorges. The series is continued by Lakes Rudolf (salt) and Stefanie in the N.E., and, according to some authorities, by the ancient lake now the Red Sea, and by the Dead Sea in Palestine. The great Victoria Nyanza, which touches the equator on the north, is of a different type, as are Lake Bangweolo (another flooded swamp) on the S. of Tanganyika, and Lake Mweru in the N. of Bangweolo. Lake Rikwa or Leopold, between Nyassa and Tanganyika, is partly of the rift type, while Lake Ngami in the Kalahari region is a swamp which sometimes dries up. Lake Leopold II. and Lake Malumba are attached to the lower Kongo. Lake Dilolo is in the swampy region forming part of the watershed between the Kongo and the Zambezi. There are numerous salt lagoons in the N. portion of the Sahara.

Climate.— The climate of Africa is mainly influenced by the fact that, except the countries on the N. and S. coasts, it lies almost entirely within the tropics. The equator, as already observed, cuts it nearly through the middle, so that it belongs in latitudinal, though unequally in longitudinal extension, to the N. and S. tropics. It is the only continent which extends unbroken from the N. to the S. tropics, and is consequently the hottest of all. The two sections N. and S. of the equator have, as has already been observed, in some respects a very considerable resemblance in their general features, the chief modifying circumstances being the greater elevation and the smaller longitudinal extension of the southern division, which, by bringing it more within the influences of the ocean, tends to modify its climate.

In the belt immediately under the equator, both N. and S., vegetation is intense and rain abundant. For about 10° N. and S. we find true tropical forests, mainly to the W. of the great lakes, on the middle and upper Kongo and its affluents, and along a belt of the W. coast in the Niger region. To the E. of the great lakes, where the rainfall is not so abundant, are considerable areas of poor steppe and scrub country, and generally over the tropical region the trees are scattered and the country more park-like than forestal. Animal life, from herds of elephants to innumerable swarms of insects, abounds in these luxuriant regions. To the N. and S. of the equatorial belt, as the rainfall diminishes, the forest region is succeeded by open pastoral and agricultural country. This pastoral belt extends, in the N., across the Sudan, from Senegambia to Abyssinia; on the S., from Angola and Benguela to the Zambezi. This is followed by the rainless regions of the Sahara on the N. and the Kalahari desert on the S., extending beyond the tropics, and bordering on the agricultural and pastoral countries of the N. and S. coasts, which lie entirely in the temperate zone.

The winds and rains in Africa are chiefly produced by the successive exposure of the various intertropical belts to the vertical rays of the sun. The monsoons of the Indian Ocean exercise the principal modifying influence. From March to September the S.W. monsoon blows from Africa to Asia, and during the remaining months the N.E. monsoon blows toward the African coast. The indraught of air charged with moisture, at the seasons when the sun is overhead, produces the rainy seasons within the tropics, and as the incessant rarefaction of the air by heat continually draws in fresh supplies, the rainfall is on the whole abundant, varying from 50 to 100 inches in the region between 10° N. and the Tropic of Capricorn. In a patch on the Gulf of Guinea the 100 inches is exceeded, though in Somaliland there are almost rainless patches. Near the tropics, to which the sun comes only once a year, there is only a single rainy season, while in the central part of the zone, which the sun traverses twice in his passage between the tropics, there are two distinct rainy seasons, a greater and a less, according as


AFRICA
(Political)
SCALE
840 Statute Miles to one inch
Capitals of Countries ★ Other Cities •
Comparative Area
KANSAS
E U R O P E
A S I A
A R A B I A
BLACK SEA
MEDITERRANEAN SEA
RED SEA
GULF OF ADEN
PERSIAN GULF
ATLANTIC OCEAN
INDIAN OCEAN
GULF OF GUINEA
Strait of Gibraltar
AZORES (PORT.)
MADEIRA IS. (PORT.)
CANARY IS. (SPAN.)
CAPE VERDE IS. (PORT.)
MOROCCO
ALGERIA
TUNIS
TRIPOLI
FEZZAN
BARKA
EGYPT
LIBYAN DESERT
NUBIA
RIO DE ORO
S A H A R A
FRENCH TERRITORY
S U D A N
SENEGAL
UPPER GUINEA
NIGERIA
KAMERUN
L. Chad
BR. EGYPTIAN SUDAN
ABYSSINIA
BR. SOMALI LAND
ITAL. SOMALI LAND
BRITISH EAST AFRICA
Mt. Kenia
Mt. Ruwenzori
CONGO INDEPENDENT STATE
FRENCH CONGO
GERMAN EAST AFRICA
BRITISH CENTRAL AFRICA
ANGOLA (PORT.)
LOWER GUINEA
RHODESIA
PORTUGUESE E. AFRICA
MADAGASCAR
ANTANANARIVO
GERMAN S.W. AFRICA
BECHUANA LAND
TRANSVAAL
NATAL
CAPE OF GOOD HOPE
CAPE TOWN
Port Elizabeth
Tropic of Cancer
Equator
Tropic of Capricorn
ASCENSION I. (BR.)
ST. HELENA (BR.)
Algiers
Tangier
Fez
Wargla
Ain Salah
Cairo
Alexandria
Wadi Halfa
Mecca
Timbuktu
St. Louis
Bathurst
Freetown
Monrovia
Lagos
Abeshr
Omdurman
Khartum
Fashoda
Harar
Addis Abeba
Mombasa
Zanzibar
Loanda
Benguela
Boma
Salisbury
Bulawayo
Pretoria
Johannesburg
Kimberley
Inhambane
Delagoa Bay
Longitude West 20° from Greenwich
Longitude East from 20° Greenwich


AFRICA
(Relief)
SCALE
0 200 400 600 800 1000
840 Statute Miles to one inch.
Dark Brown indicates highest land
Dark Blue indicates deepest water
Strait of Gibraltar
MEDITERRANEAN SEA
RED SEA
GULF OF ADEN
GULF OF GUINEA
ATLANTIC OCEAN
INDIAN OCEAN
MOZAMBIQUE CHANNEL

the wind is in a direction which brings more or less moisture, except in some places in the interior, where the two rainy seasons are so protracted as to blend into one, lasting, as in the Manyuema country, from September to July, or in some other parts even longer. The rainy season usually begins soon after the sun has reached his zenith, but on the E. coast the monsoon charged with the moisture of the Indian Ocean brings it earlier. In the deserts, as already observed, there is hardly any rain; and this applies also to Egypt, which but for the Nile would be no better than the Sahara. The chief cause of the rainlessness of the deserts is the direction of the winds, which causes the chief moisture-bearing currents to pass, before reaching them, over hot and thirsty regions which deprive them of their moisture; and especially the mountain screens which intercept the moisture of the winds both from N.E. and S.W. Another cause is the want of elevated regions to attract the moisture actually contained in the atmosphere, as in the higher regions of the desert periodical rains do occur. The high mountains of the E. plateau and the intervening tropical regions deprive the N.E. monsoon of all its moisture before it reaches the Kalahari Desert. Hence the apparently anomalous circumstance that the greatest heat is found after the equatorial region is passed. The rapid radiation of heat in the desert causes a very great fall of temperature after the sun is down, so that sometimes frosts are generated, and this in some measure supplies the want of rain by condensing the moisture in dew. In the desert, too, scorching winds are generated, those of the N. afflicting Egypt and the countries on the Mediterranean coast. The hottest part of the Sahara is in Nubia, where the Arabs say the soil is like a fire and the wind like a flame. The coasts of tropical Africa, especially the W. coast, where colonial settlements have been formed, have been found to have a deadly climate for foreigners.

Geology, Minerals.— The geology of Africa is still very little known. Very ancient crystalline rocks are found rising into mountain ranges and sometimes spread over large areas. Most of the rocks that overlie them belong to the older formations, so that the continent as a whole is supposed to be of very ancient date. The sands which cover so large an area are believed to be mainly of æolian origin, and not to have been formed by the action of water. The porous clay found so abundantly in west Africa is of comparatively recent date. The region around Tanganyika is of Jurassic origin. Around the great lakes are abundant evidences of enormous volcanic activity at no very remote date; and, as already mentioned, active volcanoes are not unknown. Tanganyika, according to recent views, may at one period have been connected with the sea. Salt is abundant, though often scarce from want of communication and working organization. Gold is found in abundance in southern Africa from the Transvaal region to the Zambezi, and a number of very productive mines have been opened in the Transvaal. Diamonds have been found in large numbers, and in apparently inexhaustible supply, on the Vaal River and its tributaries. In the southern central district, particularly the country of Katanga, iron and copper are found, and are worked in some districts in the countries bordering on the Lualaba. Copper is also found in Loanda, iron in Angola, and lead, tin, iron, and copper in Great Namaqualand; iron, copper, and coal are found in Natal.

Vegetation.— The centre of Africa possesses, as already mentioned, an exuberant tropical vegetation. The open pastoral belt at the extremities of the tropics is distinguished by a rich and varied flora. A special characteristic of the vegetation of the southern extremity of Africa is the remarkable variety, size, and beauty of the heaths, some of which grow to 12 or 15 feet and form miniature forests. Cycadaceæ and bulbous and orchidaceous plants, aloes, and other succulent plants, also abound. The baobab or monkey-bread tree, first discovered by Adanson in Senegal, is found from the Sudan to Lake Ngami, and palms of one variety or another are diffused over almost every part of Africa. The date palm is the special characteristic of the desert, to which it is peculiarly adapted, and there it forms the principal means of subsistence. It is also cultivated as a garden plant in the northern coast regions. This district as well as Egypt has an ancient celebrity for its fertility in grain. Wheat and maize are cultivated, fruit trees also abound, and groves of oranges and olives distinguish the landscape. The castor oil plant, the fig tree, the dwarf palm, and the lotus, formerly an important article of food, are here characteristic forms. The common oak, the cork oak, and the pine form the staple, and the cypress, myrtle, arbutus, and fragrant tree heaths the ornaments of the woods. The pastoral tropical belt presents a different order of vegetation. Besides the baobab, the cabbage palm, the oil palm, the wax palm, the shea butter tree, the cotton tree, the African oak, and the mangrove here prevail; rice and maize are cultivated; the principal fruits are the banana, papaw, custard apple, lemon, orange, and tamarind. India-rubber plants are found in various forms, as trees and as climbing plants, in abundance both in east and west tropical Africa. The prevalent plants of this district are also found in the fertile parts of Nubia. To the northeast of this region frankincense, myrrh, cinnamon, and cassia abound. The coffee plant is a native of the southern Abyssinian region, and also of western tropical Africa, where it forms thick woods. This plant is supposed to have been transported from Africa to Arabia. Abyssinia, though coffee and spices are native products, possesses generally, from its elevation, the vegetation of a temperate region. The swamps of the tropical region abound with papyrus. The cassava, yam, pigeon-pea, and ground-nut are cultivated as bread plants.

Animals.— The fauna of Africa is extensive and varied, and numerous species of mammals are peculiar to the continent. According to a scientific view of the geographical distribution of animals, the north of Africa belongs to the Mediterranean sub-region, while the rest of the continent forms the Ethiopian region. Africa possesses numerous species of the order *Quadrumana* (apes and monkeys), all of which are peculiar to it. They abound especially in the tropics. The most remarkable are the chimpanzee and the gorilla. The lion is the typical carnivore of Africa. Latterly he has been driven from the coast settlements to the interior, where

he still reigns king of the forest. There are three varieties, the Barbary, Senegal, and Cape lions. The leopard and panther rank next to the lion among the carnivora. Hyenas of more than one species, and jackals, are found all over Africa. Elephants in large herds abound in the forests of the tropical regions, and their tusks form a leading article of commerce. These are larger and heavier than those of Asiatic elephants. The elephant is not a domestic animal in Africa as it is in Asia. The rhinoceros is found, like the elephant, in Middle and Southern Africa. Hippopotami abound in many of the large rivers and the lakes. The zebra and quagga were numerous in central and southern Africa, but the latter is said to be now entirely extinct. Of antelopes, the most numerous and characteristic of the ruminating animals of Africa, at least 50 species are considered peculiar to this continent, of which 23 used to occur in Cape Colony. The giraffe is found in the interior and is exclusively an African animal. Several species of wild buffaloes roam in the interior, and the Asiatic buffalo has been naturalized in the north. The camel, common in the north as a beast of burden, has no doubt been introduced from Asia. The horse and the ass are highly developed in the Barbary States. The cattle of Abyssinia and Bornu have horns of immense size but extremely light. In Barbary and the Cape of Good Hope the sheep are broad-tailed; in Egypt and Nubia they are long-legged and short-tailed. Goats are in some parts more numerous than sheep, especially in the Sudan and in Abyssinia. Dogs are numerous, but cats rare, in Egypt and Barbary. The former in the northern towns serve as scavengers. Bears and foxes are found only in the north. The birds of northern Africa are almost identical with those of the south of Europe and the Asiatic countries bordering on the Mediterranean. Many of the African birds are famed for the brilliancy of their plumage, such as the sun-birds, bee-eaters, rollers, plaintain-eaters, parrots, and kingfishers. The ostrich is found nearly all over Africa, but especially in the desert. A remarkable bird of southern Africa is the secretary-bird or serpent-eater, which renders great service to the inhabitants by killing serpents. Another peculiar bird of South Africa is the little honey-guide (q.v.), which points out the nests of bees. The whale-headed stork, remarkable for its enormous beak, may also be mentioned. Owls, falcons, eagles, and vultures are numerous. Water-fowl are abundant on the lakes and rivers, and there are many species of quails and partridges. One species of gallinaceous bird, the guinea-fowl, has been domesticated in other countries. Reptiles, owing to the dryness of the climate, are comparatively few. The largest is the crocodile, which abounds in the great rivers and tropical lakes. There are several species of venomous serpents, including the horned viper and the African cobra. The chameleon is common. The rivers and coasts abound with fish of numerous species, and some of them of the most brilliant coloring. Insects are numerous. Among the more troublesome species are the locust, tsetse, and white ant.

Inhabitants, Civilization, etc.— There is a marked distinction between the races in the north and east of the great desert and those in central Sudan and the rest of Africa and the south. The main elements of the population of north Africa, including Egypt and Abyssinia, are Hamitic and Semitic, but in the north the Hamite Berbers are mingled with peoples of the same race as those of prehistoric southern Europe, and other types of various origins, and in the east and southeast with peoples of the negro type. The Semitic Arabs are found all over the northern region, and even in the western Sahara and central Sudan, and far down the east coast as traders. The Somalis and Gallas are mainly Hamitic. In central Sudan and the whole of the country between the desert and the Gulf of Guinea the population is pure negro — people of the black, flat- or broad-nosed, thick-lipped type, with narrow heads, woolly hair, high cheek-bones, and prognathous jaws. Scattered among them are peoples of a probably Hamitic stock. Nearly the whole of the narrow southern section of Africa is inhabited by what are known as the Bantu races, of which the Zulu or Kaffir may be taken as the type. The languages of the Bantu peoples are all of the same structure, even though the physical type vary, some resembling the true negro, and others having prominent noses and comparatively thin lips. The Bushmen of southern Africa are of a different type from the Bantu, probably the remains of an aboriginal population, while the Hottentots are apparently a mixture of Bushmen and Kaffirs. Scattered over central Africa, mainly in the forest regions, are pygmy tribes, who are generally supposed to be the remains of an aboriginal population. The bulk of the inhabitants of Madagascar are of Malay affinities. The total population is estimated at about 150,000,000.

As regards religion, a great proportion of the inhabitants are heathens of the lowest type. Mohammedanism possesses a large number of adherents in northern Africa and is rapidly spreading in the Sudan. Christianity prevails chiefly among the Copts of Egypt, the Abyssinians, and the natives of Madagascar, the latter having been converted in recent times. Elsewhere the labors of the missionaries have been attended with promising success. Over a great part of the continent, however, civilization is at a low ebb, and in the Kongo region cannibalism is extensively prevalent. Yet in various regions the natives who have not come in contact with a higher civilization show considerable skill in agriculture and various mechanical arts, as in weaving and metal-working. Among articles exported from Africa are gold and diamonds, palm oil, ivory, wool, ostrich feathers, esparto, cotton, caoutchouc, etc. See paragraph *Commercial Conditions* at end of this article.

Languages.— The languages spoken on the continent may be divided into two great classes, those native to Africa and those brought in from outside: the former including the three great divisions of Negroid, Hottentot-Bushman, and Hamitic, the latter Aryan, Malay, and Semitic; and the latter again into the pure languages or *patois* of recent immigrants or traders, and those which have become naturalized by time and change into virtually native tongues themselves.

The first division of the extra-African tongues comprises: (1) Pure English in South Africa and Liberia, pure French in Algeria and the scattered trading settlements elsewhere. (2)

MARIBOU STORK (*Leptoptilus crumeniferus*) AFRICAN JABIROU (*Mycteria senegalensis*)

Four «creole» dialects: the Mediterranean «lingua franca» or trade jargon; the English creole or West African Kru-English; the Cape Verde Islands Portuguese creole; and the Boer and Hottentot Dutch creole. The last three are European in stock, but with much African phonic, inflectional, and syntactical mixture and influence. The second division includes the Malay or Malagasy of Madagascar, and the Semitic tongues of the northeast. These last are (1) Pure Arabic (the Latin of Africa, the universal language of social intercourse and trade wherever Mohammedanism prevails), including the Egyptian, Sudani, Maghreb, and Muscat dialects; (2) mixed, as the Abyssinian dialects, derived from the ancient Geez (q.v.), Tigré and Tigriña, Amharic (originally of southern Abyssinia, but now the chief tongue of the country), Harari of the Galla country, Gurague, etc. All these were brought in by Semitic invaders.

The native African stocks are classed in English books mainly according to the system adopted from Friedrich Müller by R. N. Cust in his ‹Modern Languages of Africa›; later German Africanists prefer that of Lepsius, the chief difference being on the relations of Bantu and Negro or Nigritic.

1. Negroid. This has three main divisions: (1) Bantu, a pure language. This immense group occupies, with enclaves of Hottentot-Bushman and Pygmy, the whole vast triangle from the Kamerun west and Zanzibar east down to the Cape, or pretty much all Africa south of the equator. All its components (for which see BANTU) have one grammar though different vocabularies; the greatest and perhaps purest representatives of it are the Zulus or Kaffirs, and their neighbors the Se-chuana. (2) Nigritic, Negro, or Sudan-Negro, between the Sahara and the equator. Ethnologically, the races speaking this group of tongues are the purest types of the Negro stock; but linguistically, they are only classed together from the utter impossibility of grouping them with any others, though Lepsius thinks them degenerated Bantu, — a conclusion scouted by others, the affinities being very faint. They are many and to all appearance totally unrelated, so diverse and peculiar are the idioms; some, however, think they show marked characteristics in common. They doubtless represent the oldest races on the continent, wandering in small hostile bands and changing their dialects almost from generation to generation, like all such petty camps with unfixed traditions and no general intercourse; and may well have scores or hundreds of «languages» among them with no traceable connection. (3) The Nuba-Fulah or Ful; sometimes called the Nilotic, from its main seat in the Nile valley from Nubia to the Albert Nyanza, and with isolated tribes farther out, as the Barea and Kunama on the northern border of Abyssinia, and the Masai and Oigob southwest. Others dispute the inclusion of the Fulah, considering it a tongue by itself; perhaps a mongrel, more likely a family as above, which has picked up some Hamitic words. The Dinka, Bari, and Shilluk are its chief families along the Nile, the Lur or Shuli and Madi being the last to the south; west of the valley it shades into the Nigritic chaos.

2. The Hottentot-Bushman. This is the language of the dwarf tribes, and its relations to others or itself are vigorously debated. Müller thought it represented two ethnological and linguistic divisions. Lepsius thinks it one, Bantu in race and Hamitic in language; but his conclusions are not accepted. Besides the main stock in southern Africa, this group includes the Pygmy dialects in central Africa: it is denied that they have kept their original languages, but this is true of many others, and the ethnological and linguistic problems have no necessary relation.

3. Hamitic. This includes (1) the Libyan or Berber dialects spoken across north Africa from the Canaries to Egypt — probably changed scores of times from top to bottom; (2) the ancient Egyptian, with the four dialects of its descendant Coptic (extinct save as the ritual language of the Coptic Church); (3) the non-Semitic or Kushite Abyssinian dialects (formerly called Punic, sometimes Ethiopic, which was more generally applied to Geez): as Bishari (see BISHARIN), the ancient Bedja, between Egypt and Abyssinia; Danakil (q.v.) or Dankali, native name Afar, between Abyssinia, Massowa, and Obok; Somali and Galla, in their countries; Agau (through Abyssinia, the users believed to be its aborigines, with dialects as Chamir, Quara, etc.); Saho, between Abyssinia and Adulis Bay; Kaffa, Kullo, etc., in the highlands south of Abyssinia. The Fulah group (see above) and the Haussas in Sokoto have some Hamitic admixture. These Hamite tribes are much mixed, geographically or more intimately, with Semitic and Negro tribes or elements.

«Equatorial» is a name given in 1889 by Müller to a group of Negro tribes S. of Darfur, of which he wished to make a new family: the Nyam-Nyam and Monbuttu were the chief. All are of a lighter color than the typical Negro, and their languages are more distinctive still. As above said, it is probable that many such groups can be segregated on the best of grounds.

Systems of Writing.— Africa has four living systems (not counting the fossil Coptic or the European used by those races), and has had four now represented only by inscriptions or papyri. The latter are: (1) Ancient Egyptian, passing from hieroglyphics (a mixture of ideograms and syllables) through the cursive hieratic to the more cursive demotic, the ordinary script of business life. A few of the demotic characters are preserved in the ritual Coptic. (2) Ancient Phœnician, the ancestor of all Western alphabets. (3) Ancient Ethiopian, used for the native tongue around Napata and Meroë. It was cursive and borrowed, but it is not known from whence, nor what language it represents. (4) Ancient Libyan or Numidian, borrowed from southern Arabia and read from the bottom up. There are many inscriptions in it in Algeria and Tunis, some of which have been deciphered; the first was the celebrated bilingual inscription of Takka. The living systems are practically those of the Hamites and Semites, the others being mostly below the grade of civilization which uses such things; and both the former use Semitic systems. The four are:

1. The only one developed in a Negro tribe, and with one exception the only one actually invented and popularly used within historic times: that of the Vei, on the west coast near Cape Mt., devised about 1834 by Doalu Bukere, a native

with a rough knowledge of European printing. It was not an alphabetic system, but a syllabary, with complicated characters like hieroglyphics. It was later used for Mohammedan missionary work, but is being supplanted by the European system, the Christian missionaries refusing to employ it.

2. That of the Touaregs or Saharan Berbers, called *tifinaghen*. It seems to be a descendant of the ancient Libyan, to which it is similar in reading from the bottom up.

3. The Arabic, used by all who wish to write the great language of Mohammedan Africa, the general medium of social and business communication. It is also widely used to write other African languages: by the Berbers and Suahelis for Libyan; by the people of Shoa for Amharic, and those of Harar for Harari; by the Malays of Madagascar; and by the Kaffirs.

4. The Amharic, used largely in and around Abyssinia; it is an extension and modification of the ancient Geez or Ethiopic, which therefore we have not classed as dead, any more than the Greek and Roman alphabets can be so called. It is written from left to right like the European languages, the other Semitic systems being the reverse; and the vowels are indicated by modifications of the consonants or marks added to them, making it a semi-syllabic rather than pure alphabetic system. It was borrowed from southern Arabia, and can be traced back to the 4th century on the monuments at Axum, the ancient capital of Abyssinia.

Political Divisions.— By recent arrangements, mainly since 1884, great areas in Africa have been allotted to Great Britain, France, Germany, Portugal, Belgium, and Italy, as coming within their respective spheres of influence, in addition to colonial possessions proper. The areas claimed by the various European powers in Africa may be roughly estimated as follows: France, 3,500,000 square miles; Great Britain, 2,600,000 square miles; Germany, 1,000,000 square miles; Portugal, 825,000 square miles; Kongo Free State, 900,000 square miles; Italy, 180,000 square miles; Spain, 154,000 square miles. See paragraph on *Colonies* under these various countries. Egypt, like Tripoli, is nominally under Turkey, but it is actually under British suzerainty. The Kongo Free State is under the king of Belgium. Abyssinia and Morocco are the chief native African and independent states. The former independent Boer republics, the Orange Free State and the South African Republic, since the Transvaal war 1899–1902, have been incorporated with the British empire under the name of the Orange River and Transvaal Colonies. In 1903 Great Britain also annexed Kano and Sokoto.

History of Discovery.— Although in Egypt and along the Mediterranean coast (see CARTHAGE and EGYPT) Africa was the seat of remote and comparatively high states of civilization, up to the middle of the 19th century the whole of central Africa was a blank; it is now at least as well known as South America. The civilized nations of the ancient world aproached Africa from the Mediterranean and the Red Sea; there is reason to believe that till the introduction of the camel in the 7th century A.D. the desert was an insuperable barrier between the Mediterranean countries and central Sudan.

The name Africa is mythologically associated with Afer, a son of the Libyan Hercules; but this is only an eponym. It is certainly Phœnician, and probably meant "nomadic," a term applied by the Carthaginians to the tribes around. It was the name given by the Romans at first only to a small district of Africa in the immediate neighborhood of Carthage, and nearly corresponding with the Roman province formed on the destruction of Carthage. The Greeks called Africa Libya, and the Romans often used the same name. The first African exploring expedition on record is that mentioned by Herodotus as having been sent by Pharaoh Necho about the end of the 7th century B.C. to circumnavigate the continent. The navigators, who were Phœnicians, were absent three years, and according to report they accomplished their object. The story has been the subject of much controversy, and was for long generally discredited, but recent authorities of weight have pronounced in its favor. The next important voyage recorded is that of Hanno, a Carthaginian, down the west coast, probably 50 or 100 years later. He passed a river with crocodiles and river-horses, and probably reached the coast of Upper Guinea. Herodotus also mentions some young men of the tribe of the Nasamones (living near the Gulf of Sidra) crossing the desert in a westerly direction, and coming to a great river where they saw crocodiles and black men, but it is doubtful if this could have been the Niger. There is no evidence that the Egyptians knew the Nile beyond the site of Khartum, though they may have sent ships as far as the coast of Somaliland by the Red Sea. Nero sent an expedition up the Nile which seems to have penetrated up the White Nile; and remains of Roman origin have been found some distance into the Sahara. From the navigators and traders that frequented the east coast of Africa, Ptolemy may have learned that the Nile issued from two great lakes about the equator. Mohammedanism was carried into north Africa in the 7th century and very rapidly spread to the Atlantic. By the 10th century the Arabs had crossed the desert, and between this and the 14th century Arab travelers visited central Sudan, the Niger, and other regions, and till comparatively recently they were the great authorities on much of central Africa.

The first impulse to a more complete exploration of Africa was given by the Portuguese prince known as Henry the Navigator, who in the early part of the 15th century sent out a series of expeditions along the west coast. These were continued after his death, so that in 1486 Bartolomeu Diaz doubled the Cape and in 1497 Vasco da Gama sailed up the east coast as far as Mombasa, and thence to India. Thus for the first time the main outline of the African coast was laid down. Settlements were planted on the east and west coasts by Portuguese, French, English, Dutch, and Brandenburgers, but there is no authentic information that any European penetrated into the interior. Maps of the 16th to the 18th century were covered with lakes and rivers, but these were swept away as unauthentic by D'Anville in the middle of the 18th century, and the interior left a blank. An association for the exploration of inner Africa was formed in London in 1788. Additions were made to geography under its auspices by Mungo Park, Hornemann, Burckhardt, and others.

AFRICAN ART.

1. Horn Comb.
2. Battle Axe.
3. Woman's Girdle.
4. Club and Dagger.
5. Head Ornament.
6–7. Fetich Figures.
8. Woman's Sandal.
9. Woman's Head-Dress.
10. Basketry.

Modern African exploration may be said to begin with Mungo Park, who reached the upper course of the Niger or Joliba, and whose efforts to explore the river to its mouth cost him his life (1795–1805). Dr. Lacerda, a Portuguese, about the same time reached the capital of Cazembe, west of Lake Bangweolo, where he died. Hornemann, who traveled for the same society as Park, perished in the desert after sending home accounts of Bornu and the neighboring states. In 1802–6 two Portuguese traders crossed the continent from Angola, through Cazembe's dominions, to the Portuguese possessions on the Zambezi.

In 1816 Captain Tuckey, in command of a British expedition, sailed up the Kongo, which he took to be the mouth of the Niger, for 280 miles. About the same time Major Peddie, and after his death Captain Campbell, led a party up the Senegal through the Fula or Fellatah territory, returning to Kakundy on the Nunez. In 1817 Mr. Bowditch explored the country of the Ashantis. In 1818 a French traveler, Gaspard Théodore Mollien, discovered the sources of the Senegal, Gambia, and Rio Grande. In 1819 Ritchie and Lyon traveled from Tripoli to Murzuk, and in 1821 Major Laing made some important journeys in the Mandingo district of western Africa. In 1822–4 extensive explorations were made in northern and western Africa by Major Denham, Capt. Clapperton, and Dr. Oudney, the last of whom died on the way. The travelers proceeded from Tripoli by Murzuk to Lake Tchad. While Denham examined the south and west coasts of the lake, Clapperton proceeded west through Bornu to Sokoto, the capital of the Fellahtah country, on the Sokoto, an affluent of the Niger. Impressed with the importance of establishing political and commercial intercourse with this district, Clapperton organized another expedition for the purpose of reaching Sokoto from the west coast. Setting out from Badagry, on the east of Cape Coast Castle, 7 Dec. 1825, and passing through the kingdom of Yoruba he reached the Niger at Bussa. Here he crossed the river and traversed the kingdom of Nupe to Kano, capital of the Haussa country, which he had previously visited, and from thence proceeded to Sokoto, in the neighborhood of which, after a short residence, he died. His servant, Richard Lander, returned to Kano and attempted to proceed south through the kingdom of Zegzeg, but was compelled by the natives to return to Darroro, from which he reached the coast.

W. Allen, a naval officer, about this time accompanied a mercantile expedition up the Niger, which he surveyed for a certain distance, and in another expedition in 1848 the same officer revised and corrected his survey. Maj. Laing in 1826 crossed the desert from Tripoli to Timbuctoo, but he was killed on his return, and his papers lost. René Caillié, after living for some years on the Senegal coast learning the language and initiating himself into the religion and manners of the Arabs, made in 1827–8 a journey to Timbuctoo, and thence through the great desert to Morocco. Richard Lander, accompanied by his brother, leaving Badagry for Bussa in March 1830, ascended the river Niger to Yauri, and descending from thence reached the mouth called the Nun in November. In 1832 he traced other mouths of the river up to the main stream; and the identity of the great river which passes under various names in different parts of its course was thus established.

In the south, Livingstone, who was stationed as a missionary at Kolobeng in 1849, passed through the desert of Kalahari, reached the Zuga or Botletle, and after a circuitous route discovered its source in Lake Ngami. In 1851 he went north again, proceeding from the Zuga in a more easterly direction. In lat. 17° 25′ S., and between lon. 24° 30′ and 26° 50′ E., he came upon numerous rivers flowing north, which were reported to be affluents of a larger river, the Zambezi.

In 1848 and 1849 Krapf and Rebmann, missionaries stationed near Mombasa, saw the Kilima-Njaro and the Kenia Mountains. In 1851 Francis Galton, starting from Walfisch Bay, made an extensive survey of the Damara and Ovampo countries, in which he found high pastoral and agricultural table-lands. An expedition under the patronage of the British government started from Tripoli in 1850 to visit the Sahara and the regions around Lake Tchad. Richardson, the originator of the expedition, was joined by two Germans, Drs. Overweg and Barth. In crossing the desert from Murzuk to Ghat they found some interesting sculptures. From Ghat to Aïr they found the country wholly desert and uninhabited. On reaching Lake Tchad Richardson went to Kuka, capital of Bornu, Barth to Kano, Overweg to the native states of Mariadi and Guber. Barth and Overweg met again at Kuka in April 1851, but in the meantime Richardson had died. Overweg explored the lake, and Barth proceeded on another journey south to Massena, in the kingdom of Bagirmi. On his return the death of Overweg left him to prosecute the enterprise alone. He proceeded to Timbuctoo via Kano, and after collecting much information about the Niger and its tributaries, over a great part of the course of which he traveled on his return to Kuka, he reached Tripoli in August 1855. Dr. Vogel, who was sent to join Barth, was put to death at Wadai, and his papers were lost.

Dr. Livingstone began another journey from Kolobeng on 15 Jan. 1853. After staying a month at Linyante, capital of the Makololo, he proceeded down the Chobe to Sesheke, and thence ascended the Leambye (Zambezi) to the junction of the Liba. After returning to Linyante, and taking with him a party of Makololo, he again set out 11 Nov. 1853, reached the Liba 27 December, and proceeded to Lake Dilolo, where he found the watershed of the streams which flow north and south (feeders of the Kongo or the Zambezi) at a level of 4,000 feet above the sea. On his return journey he was confirmed in the belief that an elevated plateau here crosses the country and forms the watershed of the whole continent. He next crossed the Cassabi river, and on 4 April he reached the banks of the Kwango, both these rivers being affluents of the Kongo. Crossing the Kwanza, he reached Loanda on 31 May. On 20 September he set out on his return journey, and following pretty nearly the route by which he had gone arrived at Linyante. Starting from this place on 3 Nov. 1855, he reached the Zambezi, and proceeding down the river, and visiting its falls, called by him the Victoria Falls, arrived at

Kilimane at its mouth on 20 May 1856, and sailed for England. Thus was accomplished by Dr. Livingstone the remarkable feat of crossing the entire continent from sea to sea — the first time, so far as is known, that this was done by any European. In 1858 Livingstone returned to resume his exploration of the Zambezi regions. Entering the Congone mouth of the river in May, he ascended its tributary, the Shire, to Murchison Cataracts, visited Lake Shirwa and Lake Nyassa, traveled on or near the Zambezi to Victoria Falls, established the identity of the Leambye and the Zambezi, sailed up the Shire to Lake Nyassa, also sailed 156 miles up the Rovuma River, and returned to England in 1864.

Between 1856 and 1865 Paul du Chaillu traveled extensively on the west coast, in the neighborhood of the river Ogowe (or Ogobai). In 1861–2 Major (afterward Sir) R. F. Burton also traveled on the west coast. He ascended the Kamerun Mountains and confirmed some of the observations of Du Chaillu. A French expedition visited the delta of the Ogowe in 1864. Since then that river has been very fully explored, the principal expeditions having been those of Walker, 1866, 1873; Lieut. Aymes, 1867–8; the Frenchmen Compiègne and Marche, 1872–4; Dr. O. Lenz, 1876; and another French expedition under Savorgnan de Brazza, 1876, who took possession of a large stretch of territory for France. This territory now forms part of French Kongo, which had been traversed by various Frenchmen, including Brazza, Mizon, Le Maistre, Monteil, and others.

In 1866 Livingstone entered on his last great series of explorations, the main object of which was to settle the position of the watersheds in the interior of the continent south of the equator, and to discover the source of the Nile. Landing at the mouth of the Rovuma he proceeded southwest round the south end of Lake Nyassa, and then traveling north reached the south end of Lake Tanganyika (discovered by Speke and Burton in 1858). He afterward visited Lakes Mweru and Bangweolo in the basin of the Chambeze, the name given to a headwater of the Kongo. In 1869 he reached Ujiji, on the Tanganyika, and crossed the lake, making extensive journeys in the Manyuema country, and reached the Lualaba or upper Kongo, but could not explore it for want of boats. Henry M. Stanley, who had been specially sent by the proprietor of the New York *Herald* to search for Livingstone, met him at Ujiji on his return from the Manyuema country, relieved his necessities, and examined along with him the northern end of Lake Tanganyika. Livingstone afterward started on a fresh journey (in 1872) to determine the course of the Lualaba, intending to travel round the south side of Lake Bangweolo; but after suffering much from illness he died on the shore of this lake on 1 May 1873.

In 1872 the Royal Geographical Society organized two expeditions to go in search of Livingstone. The one, under Lieut. Grandy, sailed some distance up the Kongo; the other, under Lieut. Cameron, started from Zanzibar for Tanganyika. On ascertaining the death of Livingstone he proceeded to Lake Tanganyika, where he secured Livingstone's map and sent it to Zanzibar. He ascertained the height of the lake; found an outlet, the Lukuga, on the west side; traversed the Manyuema country; reached Nyangwe, Livingstone's farthest point on the Lualaba; proceeded south up the east side of the valley of Lomane to Kilemba in the Urua country; and reached Benguela, on the Atlantic coast, 4 Nov. 1875. The identity of the Kongo and Lualaba was at last settled by Stanley, who, between October 1876 and August 1877, descended from Nyangwe on the latter river to the mouth of the former. After helping to establish the Kongo Free State (1879–85) Stanley proceeded in 1887 with an expedition to relieve Emin Pasha, governor of Egypt's equatorial province. Following the Kongo and its tributary the Aruwimi, Stanley hewed his way through a vast forest, arrived at the Albert Nyanza, met Emin there, returned for his rear-guard and stores, and at last brought Emin and his followers to Bagamoyo, on the east coast, in 1889. He also discovered Lake Albert Edward and the lofty mountain of Ruwenzori, on the Semliki, between that lake and Lake Albert. The Portuguese Maj. Serpa Pinto journeyed from Benguela to Natal in 1878–9; the Germans Wissmann and Pogge crossed from St. Paul de Loanda to Zanzibar in 1881–2; in 1879–80 (after the death of his leader, Keith Johnston), Joseph Thomson crossed from the east coast by the north of Lake Nyassa to the east of Tanganyika, and back to Zanzibar; again in 1883–4 he explored the Masai country between the coast and Lake Victoria; Capello and Ivens went from Angola to Mozambique by way of Bangweolo in 1884–5.

One of the most interesting problems connected with African geography was the tracing of the source of the Nile. Among the first of the famous explorers in this direction was James Bruce, who in 1770 reached the source of the Blue Nile or Bahr-el-Azrek, and imagined himself to have solved the great problem. But the real source of the Nile remained long unknown, the great lakes connected with its origin being hardly dreamed of till comparatively recent times. In 1858 Burton and Speke, crossing from Zanzibar, discovered Lake Tanganyika, and the same year Speke also reached the Victoria Nyanza, but did not ascertain that it gave rise to the Nile. Speke and Grant in 1862 reached the place where the Nile leaves the lake and followed part of its course to Karuma Falls. At Gondokoro they met Sir Samuel Baker, who proceeded to investigate the unexplored part, but did not fully succeed in his object. Baker in 1871–3 returned to the scene of his explorations as the commander of an Egyptian force, and took possession of the country in the name of the Khedive, but added little to his previous geographical discoveries. He was succeeded in his command by Col. Gordon, one of whose officers, Col. Long, more fully traced the Nile between Karuma Falls and the Victoria Lake; while another, M. Gessi, first actually traced the Nile up to its outflow from the Albert Nyanza (1876).

Since 1883 the exploration of Africa has been carried out by a multitude of explorers. In the north the French have pushed south from Algeria, and French explorers, among whom M. Foureau is prominent, have added greatly to our knowledge of the Sahara. Dr. Junker devoted several years to exploring the country between the basin of the Nile and the Kongo. Mr.

Stanley in his great journey across Africa in 1876 added largely to our knowledge of Lake Victoria, and of Uganda, the country between Victoria and Lake Albert. Since the British occupation of Uganda, Col. Lugard and many other officers have mapped the country between the coast and the lakes, Uganda itself, and the country to the west. Italian and British explorers have added to our knowledge of Abyssinia and of the desert between the Nile and the Red Sea. Lakes Rudolf and Stefanie have been discovered and explored by Count Teleki and Lieut. Von Höhnel from the south, while James, Donaldson Smith, Cavendish, Robecchi, Bottego, and others have explored Somaliland and ascertained that the Omo flows into Lake Rudolf. Gregory has investigated Mount Kenia; Meyer has ascended Kilima-Njaro; Baumann and other German explorers have visited the region to the west and south of that mountain, round by the south of Lake Victoria, and on to Lake Albert Edward. In 1894 Count Götzen crossed from east to west, discovered Lake Kivu to the south of Lake Albert Edward, and a lofty active volcano near its shores, coming out by the Kongo. Many other Germans have been busy in German East Africa, while in British Central Africa, Johnston, Sharpe, Joseph Thomson, and others have filled in many blanks, and British naval officers have charted Lake Nyassa.

The unique distinction of being the first white man to traverse Africa from south to north on foot fell to the lot of an undergraduate of Cambridge University, Ewart Scott Grogan, who in February, 1898, started from Cape Town with one white companion and a few servants, and eighteen months later reached Cairo, having traveled the greater part of the distance with only the servants, as his white friend left him before the journey was half done. Mr. Grogan brought back a mass of ethnological information, having carefully investigated and described the various tribes with which he came in contact, and cleared up a number of disputed geographical points. See 'From Cape to Cairo.' London, 1900.

Several German explorers have also traversed and mapped Damaraland and Namaqualand; Lugard has explored the Uganda region: Gibbons and others have traversed the Barotse country. The officials of the Kongo Free State have laid open the courses of the numerous rivers that feed the main stream; Hinde found the Lukuga flowing into the Lualaba; Grenfell and others established the connection of the Ubangi or Mobangi tributary on the north, with the Makua-Wellé higher up, which had been explored by Junker and others. Under the auspices of the Royal Niger Company Joseph Thomson and others further explored the Niger; while the Benue and its tributaries and the German sphere in the south have been actively explored by British, French, and German travelers.

All these three nationalities, moreover, have been busy in the vast area between the Guinea coast and the great bend of the Niger. Prominent among them was Binger, who contributed more than any single individual to our knowledge of this region. The French occupation of Timbuctoo has led to the navigation and exploration of the upper and middle river by gunboats; while a French expedition followed the river from Timbuctoo to its mouth. Monteil crossed from Senegal to Lake Tchad and traversed the desert to Tripoli. French expeditions have crossed from the Kongo to the Nile, and all the river systems are now mapped in their main features. It may indeed be said that the pioneer exploration of Africa has been completed, the most important blank being the region lying between Somaliland and the upper Nile. What remains to be done is the filling up of the meshes between the vast network of explorers' routes, and this is a task which cannot be completed for many years.

Commercial Conditions.—Necessarily in so large an area with so many tribes and peoples who keep no accounts of their transactions, a considerable amount of commerce must pass without being recorded in any way, yet the annual commerce of Africa, of which statistics are available, amounts to over $700,000,000. The total imports at the ports where records are kept amounted in the latest year for which figures are at hand to $429,461,000, and the exports to $263,907,000. The principal imports were distributed as follows: Into British territory, $157,575,000; French territory, $92,004,000; Turkish territory, $77,787,000; Portuguese territory, $20,795,000; German territory, $8,336,000, and into the Kongo Free State, $4,722,000. Of the exports a large share, especially those from the south, is gold and diamonds; in the tropical region ivory, rubber, palm nuts, and gums, and in the north a fair share of the exports are products of agriculture, cotton, coffee, cacao, spices, dates, etc. The export figures of recent years are less than those of former years, owing to the hostilities in South Africa, which have both reduced production and increased local consumption.

Railroad development in Africa has been rapid in the past few years and seems but the beginning of a great system which must contribute to the rapid development, civilization, and enlightenment of the « Dark Continent.» Already railroads run north from Cape Colony about 1,500 miles, and south from Cairo about 1,200 miles, thus completing 2,700 miles of the proposed « Cape to Cairo » railroad, while the intermediate distance is about 3,000 miles. At the north numerous lines skirt the Mediterranean coast, especially in the French territory of Algeria and in Tunis, aggregating about 2,500 miles; while the Egyptian railroads are, including those under construction, about 1,500 miles in length. Those of Cape Colony are over 3,000 miles in length, and those of Portuguese East Africa and the Transvaal are another 1,000 miles in length.

Including all of the railroads now constructed or under actual construction, the total length of African railways is nearly 12,500 miles, or half the distance around the earth. In 1903 the construction of a railroad from Khartum to Suakin was begun. A large proportion of the railways thus far constructed are owned by the several colonies or states which they traverse, about 2,000 miles of the Cape Colony system and nearly all of that of Egypt belonging to the state.

That the gold and diamond mines of South Africa have been and are still wonderfully

profitable is beyond question. The Kimberley diamond mines, about 600 miles from Cape Town, now supply 98 per cent of the diamonds of commerce, though their existence was unknown prior to 1867, and the mines have thus been in operation but about 30 years. It is estimated that $350,000,000 worth of rough diamonds, worth double that sum after cutting, have been produced from the Kimberley mines since their opening in 1868-9, and this enormous production would have been greatly increased but for the fact that the owners of the various mines there formed an agreement to limit the output so as not to materially exceed the world's annual consumption.

Equally wonderful and promising are the great Witwatersrand gold fields of South Africa, better known as the Johannesburg mines. Gold was discovered there in 1883, and in 1884 the value of the gold product was about $50,000. It increased with startling rapidity, the product of 1888 being about $5,000,000; that of 1890, $10,000,000; 1892, over $20,000,000; 1895, over $40,000,000; and 1897 and 1898, about $55,000,000. Work in these mines was practically suspended during the Boer war.

The gold production of the «Rand» since 1884 has been over $300,000,000, and careful surveys of the field by experts show beyond question that the «gold in sight» probably amounts to $3,500,000,000, while the large number of mines in adjacent territory, particularly those of Rhodesia, whose output was valued at over $4,500,000 in 1901, gives promise of additional supplies, so that it seems probable that South Africa will for many years continue to be as it is now, the largest gold-producing field of the world.

Bibliography: *Archæology and Ethnology.* — Deniker, ‹Races of Man›; South African Native Races Committee, ‹Natives of South Africa, Their Economic and Social Condition.›

Fauna.— Smith, ‹Illustrations of the Zoology of South Africa.›

Geology.— Thomson, ‹Notes on the Geology of East Central Africa.›

Historical.— British Empire Series, ‹British Africa›; Brown, ‹The Story of Africa and Its Explorers›; Greswell, ‹Geography of Africa South of the Zambesi›; Johnston, ‹History of the Colonization of Africa by Alien Races›; Stanford, ‹Compendium of Geography and Travel›; White, ‹The Development of Africa.›

Languages.— Bleek, ‹Comparative Grammar of South African Languages›; Cust, ‹Sketch of the Modern Languages of Africa.›

Travels.— Burton, ‹First Footsteps in East Africa›; Cameron, ‹Across Africa›; Grogan, ‹From the Cape to Cairo›; Holub, ‹Seven Years in South Africa›; Livingston, ‹Missionary Travels and Researches in South Africa›; Loyd, ‹In Dwarf Land and Cannibal Country›; Peters, ‹New Light on Dark Africa›; Stanley, ‹In Darkest Africa.›

African International Association, an association formed in 1876 at Brussels for the purpose of establishing scientific stations in east Africa; the outcome of King Leopold's first Brussels conference of explorers and geographers to devise means for opening up Africa to civilization. At a second one the next year, after Stanley's discoveries of the immensity and prospective commercial importance of the Kongo basin, the Association planned to extend its operations there. But the territory was too vast and rich for any great nation to forego its share or let others lock up; finally all (the United States being a party) agreed to leave it to an international conference at Berlin. This opened 17 Nov. 1884 (Prince Bismarck chairman) and closed 26 Feb. 1885. The result was the creation of the Kongo Free State (q.v.), comprising the basins of the Kongo and its affluents, with the king of Belgium as sovereign: to be forever neutral, with perfectly free trade and transportation for citizens of any country whatever, no monopolies or concessions of any kind for its trade to be granted by powers adjoining, all of whom bound themselves to suppress slavery.

African Slave Trade, see Negro, The.

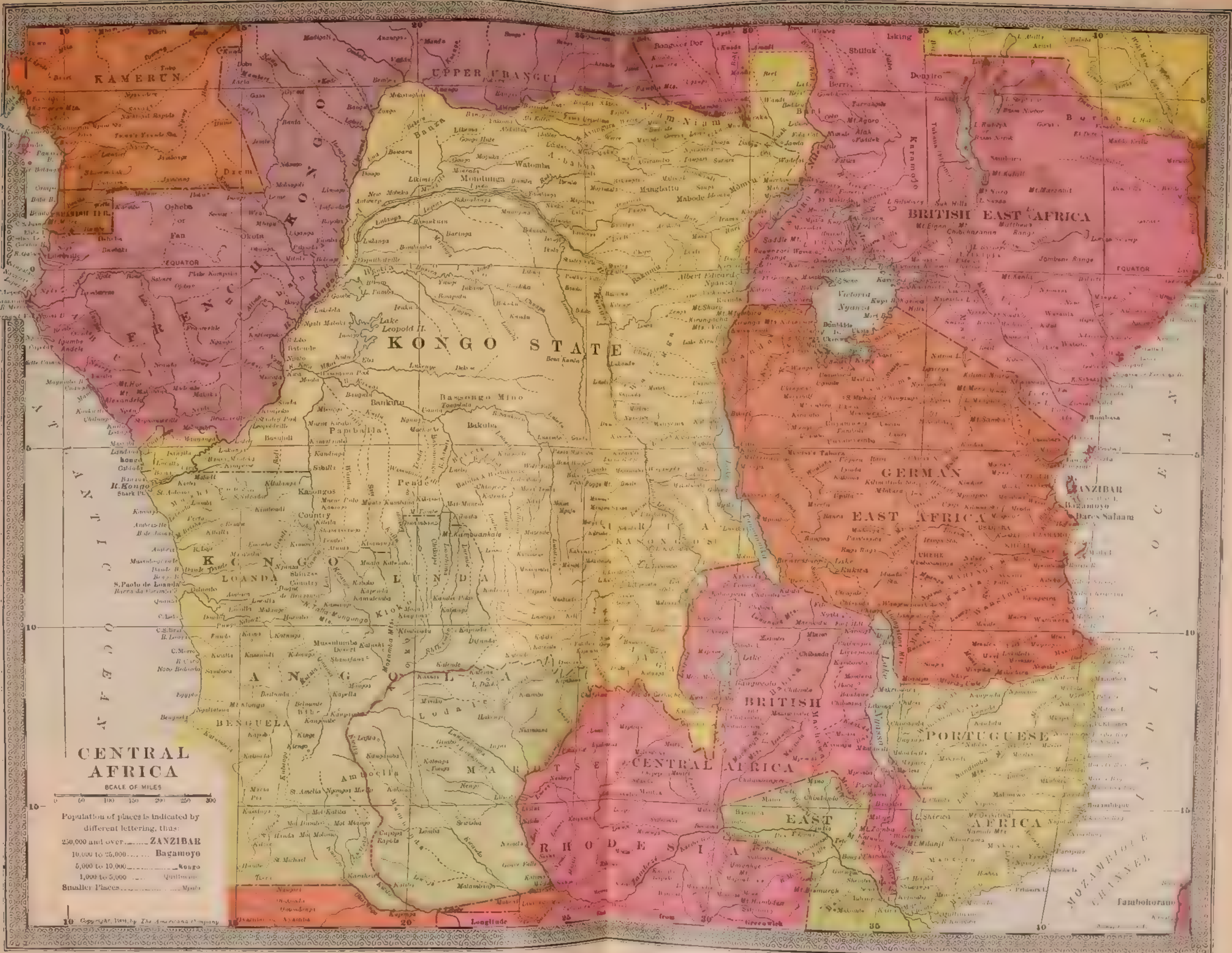
African War, The, in Roman history, Cæsar's campaign against the Pompeians who after Pharsalia kept up the war in Africa, and were crushed at Thapsus, 46 B.C. The history of it printed as Cæsar's is not his, and the author is unknown.

Afridis, af-rē'dēz, a tribe of Afghans or Pathans on the northwest Indian border near the Khyber Pass, who after many years of the customary border raids were dignified into almost a great power by the ill-advised policy of the Indian government in sending out an imposing army against them in place of the usual small punitive expeditions. The tribe sent their women into the English camp to be cared for and protected, fought for some months in their mountains till the planting season was come, then submitted and promised an indemnity, having enjoyed the highest glory and felicity their natures could appreciate. Holdich (‹Anthropological Institute› for 1899) thinks they represent the early Aryan type, wild but shrewd and civilizable.

Afrikander («Taal» Dutch for African), a native South African; commonly used for the Dutch stock alone.

Afrikander Bond or **Bund,** an association of white natives of South Africa to make native influence paramount there and ultimately secure its independence; formed in 1879, but thus named in 1880. The Cape Colony wing supported Cecil Rhodes till after the Jameson Raid in 1895, which it considered as fostered by him with objects exactly contrary to its own. It carried the elections in 1898, and while advising Kruger to grant concessions to the Outlanders for safety's sake, its sympathies were hostile to them; in the ensuing war it was a heavy handicap to the English, seeming likely at one time to add Cape Colony to the revolt; indeed, it held a convention, 6 Dec. 1900, at Worcester, C. C., condemning the war and English policy, insisting on the recognition of the South African Republic, and censuring the policy of the High Commissioner. The success of the British and the annexation of the territory to the empire of Great Britain brought about a dissolution of the organization.

After-damp, the gaseous product formed by an explosion of fire-damp (q.v.) in a coal mine. It consists largely of nitrogen from the


CENTRAL AFRICA
SCALE OF MILES
Population of places is indicated by different lettering, thus:
250,000 and over ZANZIBAR
10,000 to 25,000 Bagamoyo
5,000 to 10,000 Kongo
KAMERUN
UPPER UBANGI
FRENCH CONGO
KONGO STATE
BRITISH EAST AFRICA
GERMAN EAST AFRICA
BRITISH CENTRAL AFRICA
PORTUGUESE EAST AFRICA
RHODESIA
ANGOLA
KONGO
LOANDA
LUNDA
BENGUELA
MAROTSE
ATLANTIC OCEAN
INDIAN OCEAN
MOZAMBIQUE CHANNEL
EQUATOR
Victoria Nyanza
Lake Leopold II.
Albert Edward Nyanza
ZANZIBAR
Bagamoyo
Dar es Salaam
Longitude from Greenwich

air, and carbon dioxide formed by the explosive combustion of the hydrocarbon gas given off by the coal. It seldom contains sufficient free oxygen to support respiration. Hence its danger to the miners.

Afterglow, a display of brilliant colors in the western sky after sunset. The colors are usually various shades of red, although yellows and grays are sometimes visible. Afterglows follow volcanic eruptions of explosive character and are generally ascribed to the presence of minute dust particles in the air. The eruption of Krakatoa in 1883 was accompanied by most gorgeous afterglows which were observed throughout the world and persisted for several years. Similar effects were seen over a much smaller area after the outbursts of Mont Pelée and La Soufrière in May 1902. The name foreglow is given to such displays in the eastern sky before sunrise.

After-image, After-sensation, and **After-percept** are the terms used to denote the direct after-effects of the stimulation of a sense organ. These after-effects occur in almost all of the sense departments. A brief stimulation of the sense organ gives a primary sensation, then a pause of a fraction of a second, followed by a secondary sensation of the same quality as the primary sensation. After-images of touch follow after brief contact. They do not appear under ordinary circumstances, but may be observed if special conditions are produced; for example, a gentle tap of a point of a needle will be followed by a pause, then an after-sensation which differs from the primary sensation in that it seems to be produced from within the body, not from without. The effects of a temperature stimulus may persist for a time in the same quality as the primary sensation. After-taste and after-smell have been observed, but have not been studied. Auditory after-sensations, analogous to after-sensations of touch, are very weak and of brief duration.

After-images of vision are stronger and more permanent, consequently have been given much more attention by experimentalists. It has been found that after the retina has been stimulated by light for one second, or less, the primary image disappears quickly; an interval of less than two seconds is then followed by a positive after-image, that is, an after-image of the same quality as the primary image.

A stimulus of longer duration is followed immediately by the positive after-image, and this image may itself be followed by a negative after-image, that is, an image which differs very much in brightness from the primary image, or is of a different color. With some observers a brief stimulus is followed immediately by a negative after-image, which fades away quickly to be followed after an interval by a more permanent positive after-image. Several images may succeed each other immediately or be separated by an interval of time. A stimulus of still greater duration is followed directly by a negative after-image. In such cases the after-image is usually of a color that is complementary to the color of the primary image, especially if observed with closed eyes or if projected upon — that is, seen while looking at — a gray background. The duration of the after-image varies with the intensity, duration, and area of the stimulus. The results of experiments, under conditions such that the intensity of the light does not vary, have not as yet shown that any one color has more power to produce after-images than any other color. The greater the angular distance of the portion of the retina stimulated, from the fovea, the less distinct and the less durable is the after-image. There seems to be no after-image at an angular distance of 45° or more from the fovea. The explanation for this fact may be physiological, or psychological, or both; that is, it may be due to the fact that the periphery of the retina is more easily fatigued than the fovea, or it may be due to lack of ability to attend to those portions of the retina which are not customarily attended to. When an object occupies the attention, the eye is so directed toward it that the image falls over the fovea; the mind does not ordinarily attend to images that are not over or very near the fovea.

A blow on the head may cause the after-image to become less intense or to cease entirely. Electrical stimulation of the eye and optic nerve will change the character of the after-image and shorten the time of its duration. General fatigue will shorten the duration of the after-image; for example, it has been found that an after-image lasts about 30 per cent longer in the morning than in the evening. The distraction of attention in any manner has its effect on the course of the after-image; when the attention is directed wholly upon the after-image the duration is one third longer than when the attention is not concentrated upon it.

If one eye only be stimulated, an after-image may appear in the unstimulated eye. Four hypotheses have been offered to explain this transfer of the image from one eye to the other: (1) The appearance is a phenomenon of binocular contrast. When one eye is stimulated by a bright colored light, and the other eye is stimulated by a very little gray light or is protected from all light, the contrasted color may be seen in the unstimulated eye during the time of stimulation, and this may leave an after-image in that eye. (2) A second hypothesis is that the eyes are accustomed to function together, and whatever affects one retina affects the other also. This may be considered as a modified form of the first hypothesis. (3) Another hypothesis is that the after-image has its seat in the centres in the brain, not in the end organ or retina, and that it may be seen in whichever eye is open. This hypothesis seems to be overthrown by the fact that an electrical stimulation of the optic nerve produces a sensation like that produced by a flash of light, but no after-image follows. Another fact difficult for this hypothesis to explain is that if one eye be stimulated the after-image appears in the other eye only in case that eye be well darkened. (4) A fourth hypothesis is that the transfer of the after-image is not real but only apparent. In support of this hypothesis it has been found that when «that portion of the right eye which corresponds to the blind spot of the left eye was stimulated,» (Franz) there was an apparent transfer of the image to the left eye; also if the unstimulated eye be disturbed or interfered with during the course of the after-image no change in the image may be observed, whereas if the stimulated eye be interfered with the image disappears.

(Fechner, ‹Elemente der Psycho-physik›; S. I. Franz, ‹After-Images,› Psych. Rev., Monograph Supplement, Vol. III., No. 2, 1899; E. B. Titchener, ‹Ueber binocular Wirkungen monocular Reize.› See EYE; VISION.

Afzelius, Arvid August, äf-tsā'li-oos, ar'-vēd ow-goost', Swedish scholar and author: b. 1785; d. 1871; pastor at Enköping 1821–71; specially esteemed for his researches in Old Norse history and literature. He wrote poetical ‹Romances›; translated the Elder Edda, and with Geijer edited a famous collection of Swedish folk-songs (3 vols. 1814–17).

Ag, the chemical symbol for the element silver. It is an abbreviation of *argentum*, the Latin name for silver.

Agades, ä'ga-dez, a town of Africa, near the middle of the Sahara, capital of the oasis kingdom of Aïr or Asben; at one time a seat of great traffic, probably containing 60,000 inhabitants. In 1903 it had a population of about 6,000.

Agag, ā-gag, (1) in Jewish history, a king of the Amalekites saved by Saul out of the slaughter of his people, and hewn in pieces by Samuel before Yahwe's altar: evidently a survival of human sacrifice. (2) A character in Dryden's ‹Absalom and Achitophel,› representing Sir Edmund Berry Godfrey, the London magistrate found murdered shortly after taking Titus Oates' deposition concerning the imaginary «Popish Plot.»

A'gai, Adolf, ä-goy, a Hungarian humorist: b. 1836. He edited the chief Hungarian comic paper, *Borzsem Janko* (John Peppercorn), and wrote for it brilliant sketches of society, character drawings of national types, etc., of a high order of wit and humor.

Agalmatolite, ag-al-mat'ō-līt (from the Greek words *agalma*, image, and *lithos*, stone), a soft, massive stone, grayish or greenish in general hue, and often yellow, brown, and red, or streaked with those colors. It is soft enough to be cut with a knife, and it takes a good polish. The Chinese use it for carving images, notably small pagodas and grotesque figures of animals and men; ingenious advantage often being taken of its varied colors for the production of odd effects. The hardness of the Chinese variety is mostly from 2.0 to 2.5, and its specific gravity about 2.8. It is not a definite mineral, some specimens being silicious pinite, while others are referable to pyrophyllite and steatite.

Agama (Caribbean name), a genus of lizards, typical of the large and important family *Agamidæ*, which is distributed over all Africa (except Madagascar), Arabia, Asia south of the Caucasus and Himalayan mountains, the Malayan Islands, and Australia. None are found in the New World. They are closely related to the iguanas, and are characterized by acrodont dentition (that is, the teeth surmount ridges of the jaw), a broad and short tongue, and the absence of bony tubercles (*osteoderms*) in the skin, but large and numerous spines are often present. They may have brilliant colors, but many are dull, desert-inhabiting species. Some have parachutes, as the flying dragon, and others defensive appendages, as the frilled lizard. Prominent examples are the dragons, bloodsuckers, false chameleons, frilled lizards, spiny-tailed desert lizards, dabs, molochs, and related forms elsewhere described under their own names. The family contains about 200 species arranged in about 30 genera, and is most numerous in the region from India to Australia.

Agamemnon, in the Iliad, is the Greek «great king» or «king of kings,» the overlord of Greece both north and south of the Gulf of Corinth; the royal seat is at Mycenæ in the Peloponnesus. He is represented as a rather weak man, presiding over a turbulent assembly of practically independent feudal chiefs, who will not openly defy him because he is consecrated to his position by Zeus, but who are entirely independent as regards their individual districts, though bound to follow him to war when ordered. His character is of course purely the invention of the poet, and its relation to that of Achilles and other chiefs is curiously like that of Charlemagne to Roland and the peers in the *chansons;* the dashing noble being the real hero, and the monarch slurred as rather petty, unjust, and capricious, king by grace rather than special merit. But the position is not fictitious: archæology has proved that Mycenæ was really the seat of a wealthy and powerful monarchy, probably about 1500 B.C. and somewhat after, as well as that several Troys flourished and perished; and these proofs that the basis of the story was traditional and not mythical naturally tempt the sanguine to hope for further points of truth, which research tends steadily to justify. As to the character of the monarchy, later theorists take the reverse view from the earlier. Grote held that the account in Homer showed the germ of a developing constitutionalism, the criticising commons who were becoming a thorn in the monarch's flesh being satirized and caricatured in Thersites, and the king only an Aryan chief elected by his equals; Mahaffy thinks it the decay of a monarchy of the Oriental type, the feudal anarchy indicating break-down instead of growth. In the legend he is the son of Atreus (q.v.), and brother of Menelaus, king of Sparta, whose wrong in the seduction and carrying away of his wife Helen (q.v.) by Paris, son of Priam, king of Troy, he avenges by a levy of all the Greeks to make war on Troy, when its king Priam will not give up Paris or make him give up Helen. (See HELEN; ILIAD; TROY.) The sacrifice of his daughter Iphigenia (q.v.), to secure a passage from Aulis, is a later fiction, and recalls Jephthah and his daughter curiously. His quarrel with Achilles is the theme of the Iliad. When Troy was sacked, he received Priam's prophetess-daughter Cassandra (q.v.) among his share of the spoils. Returning home after 10 years' absence, he was murdered by his cousin Ægisthus, son of Thyestes (see ATREUS), aided by Agamemnon's wife Clytemnestra (q.v.) with whom he had been living in adultery for a short time previously; and his son Orestes on growing up avenges him by killing his mother, his sister Electra abetting. In Homer, the motive for Agamemnon's murder is simply that of any adulterous pair in ridding themselves of an inconvenient husband; in Æschylus' ‹Agamemnon,› Clytemnestra slays him with her own hand, professedly in revenge for his sacrifice of Iphigenia, obviously sharpened by jealousy of Cassandra, and throwing the ultimate responsibility on Nemesis, who is pursuing the house of Atreus.

LIZARD (*Agama colonorum*). BEETLE (*Ateuchus sacer*). HORNED VIPER (*Cerastes cornusus*).

Agamenticus, Mount, a noted landmark in York co., Maine, near which one of the earliest settlements in this territory was made in 1631. It is a few miles back from the shore and rises to the height of 673 feet.

Agamogenesis. See PARTHENOGENESIS.

Agaña, äg-än'ya, the principal town of Guam, the largest of the Ladrone Islands, 1,500 m. E. of Luzon, Philippines, and 1,300 m. S. of Yokohama. The Ladrone, or Marianne, group belonged to Spain; but, as a result of the war between the United States and Spain in 1898, the former took possession of the island of Guam, and in 1899 established a naval station and seat of administration at Agana, with Capt. Richard P. Leary, U. S. N., as first governor. The town contains the usual public buildings of a military station, and a college.

Aganippe, -nip'ē, a fountain on Mount Helicon, in Greece, sacred to the Muses, which had the property of inspiring with poetic fire whoever drank of it.

Agape, ag'a-pē (Gr. *agapē*, love), in ecclesiastical history, the love-feast or feast of charity, in use among the primitive Christians, when a liberal contribution was made by the rich to feed the poor. During the first three centuries love-feasts were held in the churches without scandal, but in after-times the heathen began to tax them with impurity, and they were condemned at the Council of Carthage in 397. Some modern sects, as the Wesleyans, Sandemanians, Moravians, etc., have attempted to revive this feast.

Agapemone, ag-a-pem'o-nē (lit. « the abode of love »), the name of a singular conventual establishment which has existed at Spaxton, near Bridgewater, Somersetshire, since 1859, the originator of it being a certain Henry James Prince, at one time a clergyman of the Church of England, who called himself the Witness of the First Resurrection. The life spent by the inmates appears to be a sort of religious epicureanism. Some of the proceedings of the inmates of the « Abode of Love » have resulted in applications to the courts of law, where parties formerly members of the society have returned to the world and sought to regain their rights from Prince and his followers, and such cases have caused some scandal; but the sect has been scarcely heard of for some years.

Ag'aphite, a name given to the turquois (q.v.) by Fischer, in 1806, in compliment to the naturalist Agaphi. It is no longer in general use.

Agar-agar, ä'gär-ä'gär, also known as Bengal isinglass. A dried seaweed or vegetable gum obtained from Singapore. It is almost completely soluble in water, dissolving to a tasteless and odorless mass. It is much used as a culture medium in bacteriology.

Agar'ic (*Agaricus*), a genus of fungi, characterized by having a fleshy cap or pileus and a number of radiating plates or gills on which are produced the naked spores. The majority of this species are furnished with stems, but some are attached to the objects on which they grow by their pileus. Over a thousand species are known, and are arranged in five sections according as the color of their spores is white, pink, brown, purple, or black. Many of the species are edible, like the common mushroom (*A. campestris*), and supply a delicious article of food, while others are deleterious and even poisonous. See FUNGI; MUSHROOMS.

Agaricic Acid, ag-ar-is'ik, a substance having the formula $C_{16}H_{30}O_5$, which is obtained from certain species of mushrooms by extraction with ether or strong alcohol. It is also soluble in hot glacial acetic acid and oil of turpentine. It crystallizes in flat, four-sided plates, and also in prisms, according to the solvent from which it is deposited, and melts at about 290° F. It dissolves in boiling water, but crystallizes out again upon cooling. A similar substance, known as agaricin, is obtained from the fly-agaric by extraction with alcohol, and Jahns states that it is identical with agaricic acid. Several salts of agaricic acid are known. See AGARIC RESIN.

Agaric Mineral, ag'a-rik, or a-gar'ik. (1) A soft, white variety of calcite, breaking easily in the fingers, and occurring in caverns and in the clefts of rocks, in regions where the ground water contains much lime. (2) A variety of silicate of magnesium, found in Tuscany, and also known as mountain-milk or rock-milk. Bricks made from it will float in water; hence it is supposed that this is the material from which the ancients made their floating bricks.

Agaric Resin, a red resinous substance, obtained from certain mushrooms, together with agaricic acid (q.v.) by extraction with alcohol or ether. It melts at 194° F. It is insoluble in water, but dissolves in absolute alcohol, ether, wood alcohol, chloroform, and alkalies.

Agassiz, Alexander, ăg'ăs-sĭ (1835), son of Louis: b. Neuchatel, Switzerland, but taken to America in 1848 and educated at Harvard College, from which he was graduated in 1855. In 1859–60 he made biological studies along the coast of California and Mexico with the United States coast survey. Later he became wealthy through investment in coal and copper mines, to which he was led by scientific knowledge and experience. On his father's death he was appointed curator of the Museum of Comparative Zoology at Harvard, but resigned in 1885 on account of ill health. In 1896 he was made an officer of the Legion of Honor. He belongs to many scientific associations, has done much important work in marine dredging and the zoology of the deep sea, as well as on other subjects. His most important publications are ‹North American Acalephæ› (1865); ‹Marine Animals of Massachusetts Bay› (with Elizabeth Agassiz, 1871); ‹Revision of the Echini› (1872); ‹North American Starfishes› (1877); and ‹Report on the Echini of the Challenger Expedition› (1881).

Agassiz, Louis (1807–73), a naturalist: b. 28 May at Motier, Canton Fribourg, Switzerland, but during the latter part of his life identified with the advancement of science in the United States. From childhood he showed a strong bent toward zoology, and, after a preparatory training at Lausanne, studied medicine and natural history at Zurich, Heidelberg, and Munich, taking a degree in philosophy at Heidelberg and graduating in medicine at Munich, 1830. After this he went to Paris and worked under Cuvier until 1832, when he was called to Neuchatel as professor of natural history, and remained there until 1846, when invited to give a series of lectures in the Lowell Institute course at Boston. The success of these lectures and

his desire to study the natural history and geology of America determined his permanent removal to the United States; in 1848 he was given the chair of natural history in the Lawrence Scientific School of Harvard University. With the interval of three years (1851–54) as professor in the medical college at Charleston, S. C., he continued his connection with Harvard until his death. His enthusiasm, eloquence, and clearness of thought made him a pre-eminent teacher, but in his later years he was relieved from the regular duties of the school.

His first great work, ‹Recherches sur les Poissons Fossiles› (5 vols., 311 plates, 1833–42), was accomplished during his professorship at Neuchatel. This was followed by ‹Fossil Fishes of the Old Red Sandstone of the British Isles,› written after making several visits to England, and by the ‹Nomenclatoris Zoölogicus Index› (Soliduri, 1842–46), which, revised and brought up to date by Scudder, was re-issued in 1882 as Bulletin No. 19 of the U. S. National Museum. During this same period he had studied both living and fossil echinoderms, and had spent many summers in observing glacial action. The most eminent European biologists, botanists, and geologists were among his friends, and he came to America with the hope not only of advancing science by his own researches, but of waking a deeper interest than American students had yet shown in the natural sciences. His first wife had died in Europe; he remarried in America, and became so engrossed with the work he had undertaken as to refuse the most flattering offers of positions in Europe. In constant demand, and traveling widely as a lecturer as long as his health permitted, he was nevertheless constantly forwarding his original work. In 1848 he made a geological and biological survey of the northern and eastern shores of Lake Superior; in 1850–51 he studied the coral reefs of Florida; later he visited Brazil and the coasts of California.

His zeal was untiring, even after his health failed; besides working through all his later life on his great series, ‹Contributions to the Natural History of the United States,› which he had planned on so large a scale that the four quarto volumes completed were but a beginning, he directed constant efforts toward the establishment of the Museum of Comparative Zoölogy at Harvard, giving more attention to it than to any other of his later interests. The plans for it were perfected in 1858, and through his influence the original endowment was supplemented by generous appropriations; he gave his own valuable collections to it, and his time and money as well; before his death the opportunities which he had created there had attracted a group of young men who were to become the foremost American biologists. The founding of a summer school where zoölogy could be studied out of doors was another of his projects, and this he accomplished on the island of Penikese, Buzzard's Bay, in 1873, just before his death.

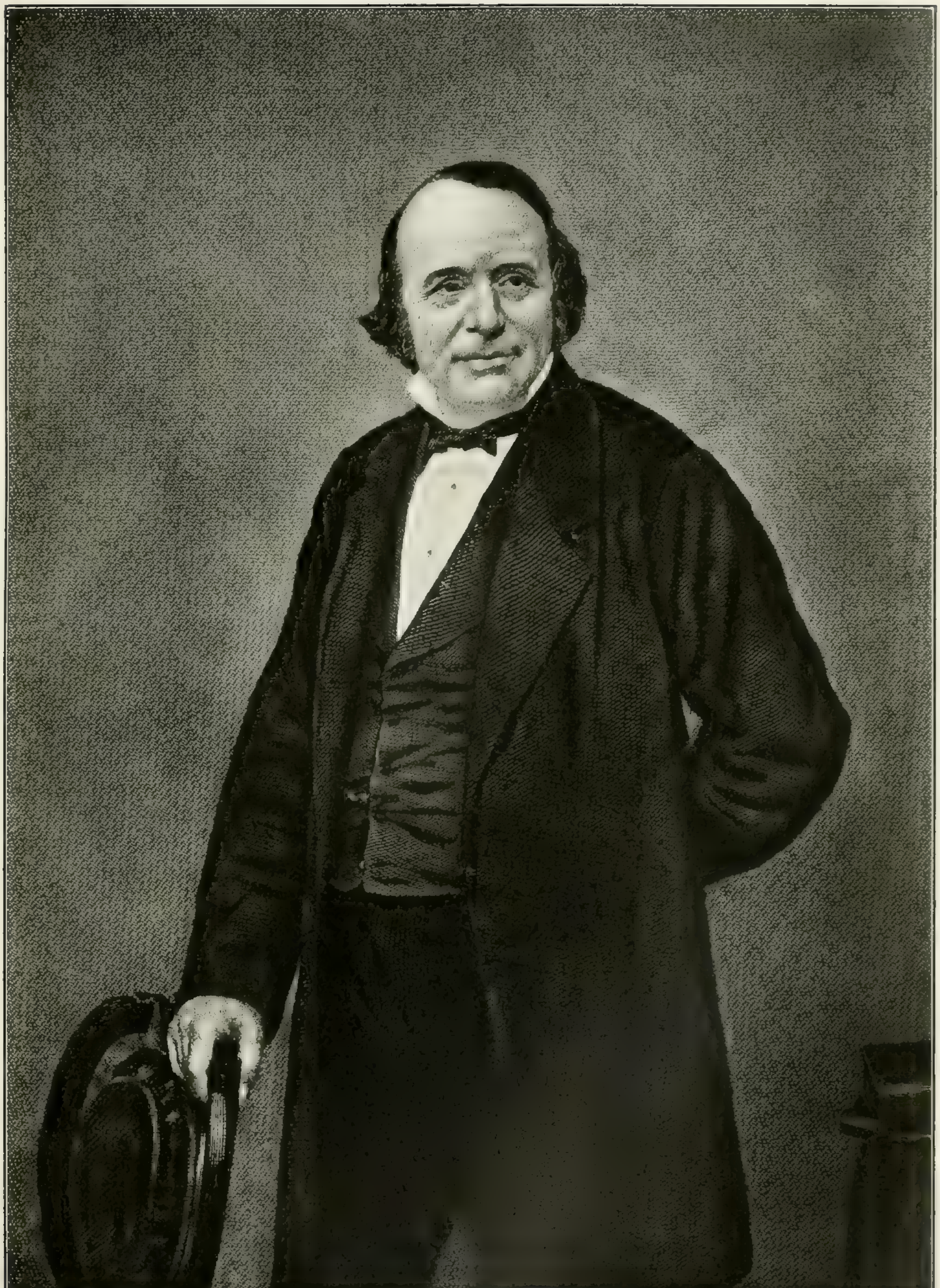
Among his more important American publications are ‹Methods of Study in Natural History›; ‹Geological Sketches›; ‹The Structure of Animal Life›; ‹A Journey to Brazil›; and ‹An Essay in Classification› (the first volume of his unfinished ‹Contributions›). The amount and scope of his work, together with his great gift of awakening interest in the natural sciences and advancing new views without rousing the opposition of the dogmatic, gave him rank as the most influential of American naturalists, although many of his opinions and theories have been superseded by the Darwinian idea of evolution, which he opposed. He died 14 Dec. 1873, and was buried in Mount Auburn Cemetery, where his monument is a boulder from the Aar glacier in Switzerland. (‹Life and Correspondence of Agassiz,› Boston, 1886.)

Agassiz, Mount, a remarkable extinct volcano situated in Arizona about 70 m. northeast of Prescott. It has an altitude of more than 10,000 feet above the sea, and belongs to the ranges of the Rocky Mountains. As a place of resort it has numerous attractions,— grand scenery, elevation, and proximity to the Colorado Cañon.

Agassiz Association, an organization for the promotion of nature study among youth. The society was established in 1875, and in 1902 had a membership of more than 12,000. The headquarters are at Pittsfield, Mass. The official publication is ‹The American Boy,› and the badge is a Swiss cross.

Agate, a variety of chalcedony, or cryptocrystalline quartz, distinguished by its banded or clouded appearance or by the presence of visible impurities. "Achates" was the Greek name of a river in Sicily near which, according to Pliny, agates were first found; but the name was earlier used by Theophrastus in his treatise ‹On Stones,› published about 315 B. C., while agate is mentioned in Exodus xxviii. 17 as one of the precious stones in the breastplate of the high priest. Its history, therefore, extends over a period of at least 3,400 years.

The method of formation of banded agates has been carefully studied by numerous investigators. M. F. Heddle (see ‹Nature,› Vol. 29, p. 419) assumes the existence of a cavity in a trap rock, which is lined during its solidification with a thin layer of green celadonite or delessite. The rock subsequently rots, and its feldspar is decomposed by water containing carbonic acid, which thus becomes highly charged with silica. This is transfused into the cavity, coagulates and is deposited on its walls. The banded structure is due to the intermittent deposition of successive layers of silica from the highly siliceous solution. It was long supposed that after the earlier layers were deposited fresh supplies of the solution passed inward through a hole called the "inlet of infiltration." This canal is often distinctly seen in agates, but the weight of evidence now seems to favor the hypothesis that the external solution supplies the silica by osmosis (q.v.). The internal solution becomes less dense as it is relieved of silica by its deposition on the walls of the cavity, and it is then replaced by the denser external solution which passes through the layers of agate already formed. If the conditions remain unchanged the process continues until the entire cavity is filled, but agates are not infrequently found with a cavity in the centre, or with crystallized quartz (often amethystine) lining the interior. Such distinctly crystallized portions may be succeeded by further deposits of the cryptocrystalline chalcedony. The successive layers often differ



LOUIS AGASSIZ.

AGATES

1, 4, 5. Carnelian Agate or Sard Agate
3. Onyx Agate 6. Bull's Eye Agate
2. Moss Agate

much in density, hardness, color, and transparency. Sir D. Brewster has shown that some of the layers are so exceedingly thin that it would take 55,760 to measure an inch. (Philos. Mag. (3) XXII., p. 213). These layers are deposited all around the cavities, following all of their irregularities. The beauty of agates is thus greatly enhanced by the extreme delicacy of their banding. Sometimes these bands concentrically encircle a dark spot, forming a «bull's eye agate,» or again they parallel a cavity with sharp angles, as in the «fortification agate.» Other agates show horizontal layers, suggesting the query as to whether the silica had settled upon the floor of the cavity from a solution at rest. Such agates are known as onyx (q.v.), or if the colors are red and white, as sardonyx (q.v.). In clouded agates there is no distinct banded structure, but the colors shade gradually from one into another.

The natural colors of agates vary greatly, being usually gray or either red or brown. The colors are due to the presence of organic impurities or to the oxides of iron, manganese, or titanium. Nearly all the agates now offered for sale are, however, artificially colored. The success of the process is due to the varying degrees of porosity of the different layers of agate, some of which readily absorb the fluid in which the stones are immersed, while others are impervious to it. The black and white agates are prepared by soaking the stones for several days in a warm syrup of honey and water, then immersing them in sulphuric acid, which carbonizes the honey absorbed by certain of the layers, making them dark brown or black. The red, or carnelian agates are produced by a process of «burning.» A grayish stone is heated in an oven for several weeks, at first gently, then it is moistened with sulphuric acid and the temperature is gradually raised to redness. Blue, or «sapphire» agates are produced by steeping the stones first in a solution of a ferric salt and then in postassium ferrocyanide, thus depositing Prussian blue in the more porous layers. A green agate is secured by the aid of chromic acid or a nickel salt, while hydrochloric acid yields a yellow agate. The red and the black are much the most popular.

For over four centuries the headquarters of the agate industry has been in the valley between Idar and Oberstein, some forty miles from Bingen on the Rhine. There are probably 150 agate mills working an average of three to five stones each in this little valley. These are chiefly operated by water-wheels 10 to 18 feet in diameter, abundant power being secured from the rapid mountain streams of the neighborhood. The millstones are of red sandstone, each about five feet in diameter, and rotate in a vertical plane, making about three revolutions per second. The workmen lie stretched in an almost horizontal position upon a low wooden grinding stool fitted to the chest and abdomen, leaving the limbs free. The hands are engaged in holding and grinding the agate, while the feet are firmly pressed against short stakes screwed into the floor, the reaction enabling the grinder to press the agate with much force against the moving millstone. During the process the agates glow most beautifully with a bright red phosphorescence. After having been ground the agates are polished with tripoli on cylinders of wood or a metal disc (see Pop. Sci. Rev., New Series, Vol. I., p. 23).

Moss-agate or «Mocha-stone» is a variety of chalcedony through which are scattered black or brown masses, more or less resembling moss. These impurities are usually one of the manganese oxides. In the Chinese moss-agate they appear as thin matted filaments of a green color, which are often artificially colored. Beautiful dendrites are sometimes found in chalcedony. The name dendritic-agate or tree-agate is given to these highly prized forms (see illustration under MINERALOGY). Moss-agates abound at many localities in the United States, especially in Wyoming.

In the «melaphyre» of the hills around Idar, agates of considerable beauty are found. Formerly they were extensively quarried there, but since 1827 the lapidaries of Idar have secured their supplies largely from Uruguay and Brazil, which countries have long furnished nearly the entire commercial supply, though Scotch agates are marketed to some extent. Small banded agates of much beauty abound on the shores of Lake Superior; large and fine specimens occur plentifully in western Texas. Agates abound in many other regions, while very many localities yield choice agates sparingly. Most of the polished agate specimens and novelties of the tourist resorts, though often purporting to be of local origin, come from Brazil or Uruguay and are polished in Germany.

Agate is used in making burnishers and agate mortars and pestles, and, owing to its hardness, for the knife edges of balances. It is worked up as a decorative stone into vases, dishes, ash trays, paper weights, paper cutters, etc., and is mounted as a semi-precious stone in a great variety of objects, such as jewel boxes, glove or shoe buttoners, watch charms, letter openers, and scarf pins. Every boy is familiar with agate marbles, but the cheaper grades of these are only glass. From the earliest times the black and white banded agate (see ONYX) and the red and white (see SARDONYX) have been used for seal rings and for carving cameos. The ancients also regarded agate as a charm against the intoxication of love.

See also Ruskin, 'On Banded and Brecciated Concretions' in Geological Magazine, 1867 to 1870; 'Ethics of Dust,' p. 190; 'The Vale of Idar,' by S. Weisse in Blackwood's Magazine, Vol. 148, pp. 75 and 208.

GEORGE LETCHWORTH ENGLISH,
Mineralogist, New York City.

Agate-shell, or **Agate-snail**, a land-snail of the carnivorous genus *Achatina* of the family *Helicidæ*. They are abundant in tropical Africa; the largest of all land-snails are found among them, and many species have brightly colored shells.

Agatha, St., a lady of Palermo, martyred by Quintilian, the pro-consul of Sicily, in the persecution of Decius, because she would not perform idolatrous worship or submit to his impure desires.

Agatharchides, ăg-a-thar'kĭ-dēz, or **Agatharcides**, ăg-a-thar'sĭ-dēz, a Greek writer on geography: b. at Cnidos in Asia Minor; lived 250 B.C. and wrote numerous works; among them, one on the Erythræan Sea, of which some extracts have been preserved. He is the earliest extant writer who attributes the annual rise of

the Nile to the periodical rains in the upper regions of that river.

Agathias, a-gā'thi-as, a Greek poet and historian, about 536–581. He collected a ‹ Cycle › of contemporary poems, in which were a few of his own compositions. We have still 101 of his ‹ Epigrams,› and the whole of his ‹ History › of the years 553–558.

Agathocles, ag-ath'ō-klēz, a Syracusan of low extraction, who became ruler of a great part of Sicily. He was remarkable for beauty, strength, and capacity for enduring labor. In the outset of life he belonged to a band of robbers; afterward he served as a private soldier, rose to the greatest honors, and made himself master of Syracuse. He conquered the greater part of Sicily, 317 B.C. Being defeated at Himera by the Carthaginians, he carried the war into Africa, where for four years he extended his conquests over his enemy. He afterward passed into Italy and made himself master of Crotona. In his 72d year he was poisoned by his grandson Archagathus, 289 B.C., after a reign of 28 years of great prosperity mingled with the deepest adversity. His son-in-law, Pyrrhus, king of Epirus, inherited his influence in Sicily and southern Italy.

Agathon, ag'a-thon, a Greek tragic poet (448–402 B.C.). He was a close friend of Euripides and of Plato; and the famous ‹ Symposium › of Plato immortalizes the banquet given on the occasion of Agathon's dramatic triumph, 416 B.C.

Agave, ag-ā'vē, daughter of Cadmus and Hermione, married Echion, by whom she had Pentheus, who was torn to pieces by the Bacchanals. She is said to have killed her husband while celebrating the orgies of Bacchus. She received divine honors after death.

Agave, a genus of remarkable and beautiful herbaceous plants, of the natural order *Amaryllidaceæ*, having a tubular perianth with 6-partite limb, and triangular many-seeded capsule. They resemble aloes in their growth and general appearance, and the best-known species, *Agave americana*, is properly known as the American aloe. This is a large plant, the leaves of which are thick, fleshy, and spinous at the edge, and the stem branched and of great height. The flowers have the tube of the corolla narrowed in the middle, the stamens longer than the corolla, and the style longer than the stamens. This magnificent native of North America is by no means an uncommon plant in English gardens, but is seldom seen there in flower. There is indeed a notion, but an erroneous one, that the American aloe does not bloom until it is 100 years old. The fact is that the time of flowering depends almost wholly on the rapidity of its growth. In hot countries it will flower in a few years, but in colder climates, the growth being slower, it is necessarily longer in arriving at maturity. The stem, which bears the blossoms, rises from the centre of the leaves, and when the plant is in a vigorous state it frequently exceeds the height of 20 feet. Branches issue from every side, and in such a manner as to form a kind of pyramid, composed of greenish-yellow flowers, which stand erect and are seen in thick clusters at every joint. When in full flower its appearance is extremely splendid; and if the season be favorable, and the plant be sheltered from the cold in autumn, a succession of blossoms will sometimes be produced for nearly three months. In the warmer parts of Europe the American aloe is cultivated as an object of considerable utility. They are frequently set out in rows as fences for inclosures, particularly in Spain, Portugal, and Italy. In some parts the leaves are employed for scouring pewter, kitchen utensils, and floors. The juice of these leaves is made into cakes, which are used for washing, and will make lather with salt water as well as with fresh. The sap when fermented yields a beverage resembling cider, called by the Mexicans *pulque*. The leaves are used for feeding cattle; the fibres of the leaves (called *pita*, *sisal hemp*, or *henequen*) are formed into thread, cord, and ropes; slices of the withered flower-stem are used as razor-strops.

Agde, äg-da, a seaport of southern France, dept. He'rault. It possesses a remarkable cathedral dating from the Middle Ages, since when the town has been the seat of a bishopric. Pop. (1902) about 8,000.

Age, any period of time attributed to something as the whole, or part, of its duration; as the age of man, the several ages of the world, the golden age.

In Law, the time of competence to do certain acts. In the male sex 14 is the age when partial discretion is supposed to be reached, while 21 is the period of full age. Under 7 no boy can be capitally punished; from 7 to 14 it is doubtful if he can; at 14 he may. At 12 a girl can contract a binding marriage; at 21 she is of full age. In mediæval times, when a girl reached 7, by feudal custom or law a lord might distrain his tenants for aid to marry, or, rather, betroth her; at 9 she was dowable; at 12 she could confirm any consent to marriage which she had previously given; at 14 she could take the management of her lands into her own hands; at 16 she ceased, as is still the law in England, to be under the control of her guardian; and at 21 she might alienate lands and tenements belonging to her in her own right. In the United States at 25 years of age a man may be a representative in Congress; at 30 a senator; and at 35 he may be chosen President. The age of serving in the militia is from 18 to 45 inclusive.

In England no one can be chosen a member of Parliament under 21 years of age, nor be ordained a priest under the age of 24, nor made a bishop until he has become 30 years of age. The age of serving in the militia is from 16 to 45 years. The sovereignty of the realm is assumed at 18; though the law recognizes no minority in the heir to the throne.

In French Law, a person must have attained the age of 40 to be a member of the legislative body; 25 to be a judge of a tribunal *de première instance;* 27 to be its president, or to be judge or clerk of a *cour royale;* 25 to be a justice of the peace; 30 to be judge of a tribunal of commerce, and 35 to be its president; 25 to be a notary public; 30 to be a juror. At 21 both males and females are capable of performing all the acts of civil life.

Ages of the World.—We find the ages of the world mentioned by the earliest of the Greek poets. Hesiod speaks of five distinct ages: (1) The Golden or Saturnian Age, when Saturn ruled the earth. The people were free from the restraint of laws; they had neither ships nor

weapons, wars nor soldiers; the fertile fields needed no cultivation, and perpetual spring blessed the earth. (2) The Silver Age, which he describes as licentious and wicked. (3) The Brazen Age, violent, savage, and warlike. (4) The Heroic Age, which seemed an approximation to a better state of things. (5) The Iron Age, when justice and honor had left the earth. The poet supposed this to be the age in which he himself lived. The idea of ages of the world is interwoven with the religious sentiments of various nations. We find examples of it in the thousand years of the Millenarians, and in the four *yugas* or ages of the Hindus. The first, or Krita Yuga, a kind of Golden Age, lasted, according to their tradition, 4,000 divine years, each equal to 360 solar years, and, adding its fore and after «twilight,» 1,728,000 solar years in all; men then lived 400 years, and were all giants; then the god Brahma was born. In the second period, the Tretâ Yuga, which lasted 3,000 divine and 1,296,000 solar years in all, men lived only 300 years, and vice began to creep into the world. During the third age, or Dwâpara Yuga, which lasted 2,000 divine and 864,000 solar years, men lived only 200 years, owing to the increase of vice. The last age, the Kâlî Yuga, that in which we now live, is to last for 1,000 divine or 432,000 solar years, and the life of man is sunk to one fourth of its original duration.

Age of Animals.—The duration of life in animals is generally between seven and eight times the period which elapses from birth till they become adult; but this rule, besides being vague and indefinite, is quite useless in practice, because it affords no scale of gradation which would enable us to ascertain the precise age of individuals, the only inquiry of real importance or of practical application to the interests of society. More certain and scientific principles are derived from observing the growth and decay of the teeth. See CATTLE; HORSE.

In Archæology.—The Danish and Swedish antiquaries and naturalists, MM. Nilson, Steenstrup, Forchamber, Thomsen, Worsaae, and others, have divided the period during which man has existed on the earth into three — the Age of Stone, the Age of Bronze, and the Age of Iron. During the first-mentioned of these he is supposed to have had only stone for weapons, etc. Sir John Lubbock divides this into two — the palæolithic, or older, and the neolithic, or newer stone period. At the commencement of the age of bronze that composite metal became known and began to be manufactured into weapons and other instruments; while, when the age of iron came in, bronze began gradually to be superseded by iron. See Lyell's ‹Antiquity of Man,› and Lubbock's ‹Prehistoric Times.›

In Physiology.— If the word age be used to denote one of the stages of human life, then physiology clearly distinguishes six of these: viz., the periods of infancy, of childhood, of boyhood or girlhood, of adolescence, of manhood or womanhood, and of old age. The period of infancy terminates at 2, when the first dentition is completed; that of childhood at 7 or 8, when the second dentition is finished; that of boyhood or girlhood at the commencement of puberty, in temperate climates from the 14th to the 16th year in the male, and from the 12th to the 14th in the female; that of adolescence

extends to the 24th year in the male and the 20th in the female; that of manhood or womanhood stretches on till the advent of old age, which comes sooner or later, according to the original strength of the constitution in each individual case and the habits which have been acquired during life. The precise time of human existence similarly varies. See LONGEVITY.

In Geology.— See GEOLOGY.

Agen, a-zhan, one of the oldest towns in France, capital of dept. Lot-et-Garonne, on the Garonne, 74 m. S.E. of Bordeaux. A fine stone bridge of eleven arches spans the river here, and the aqueduct bridge of the *Canal Latéral* is another striking structure. The town has been an episcopal see with a cathedral since the reign of Clovis, prior to which it was a Roman station. It commands an extensive agricultural trade, owing to its position between Bordeaux and Toulouse. Pop. 1903, 23,000.

Agent, in law, one person who acts for another, called the principal. If a person acts as agent without authority, the subsequent ratification of the act will make it binding on the principal just as if he had originally directed it. When an agent acts within the scope of his employment he may bind his principal, and the principal is liable for any fraudulent acts or wrong-doings of the agent so acting. If the agent, having power to bind his principal, does so expressly, he is not liable; but if he exceeds his authority he becomes personally responsible. The agent is bound to obey the instructions of the principal, and if, in violating them, he binds his principal to a third person, he is personally liable to make compensation. He cannot deal in his principal's affairs to his own profit. The right on the part of an agent to act is called his authority or power. The authority or power must in some instances be exercised in the name of the principal, and the act done is for his benefit alone. As a general rule, an agent cannot delegate his authority without special authority from his principal, consequently an agent cannot create a sub-agent without special permission. Any person may act as agent whom the principal wishes to appoint. So broad is this rule that married women and infants, who are incapable of acting in their own behalf, may act as agents, for the appointment takes away the legal insufficiency and permits them to bind their principals when they could not bind themselves. The mode of appointment depends upon the nature of the agency. By a rule of law the evidence of appointment must be of as high a nature as the thing to be done. Thus, to execute a writing under seal, the appointment must be under seal. When the authority or power is coupled with an interest, or when it is given for a valuable consideration, or when it is a part of a security, then, unless there is a special agreement that it shall be revocable, it cannot be revoked. Death, insanity, bankruptcy, the extinction of the subject-matter of the agency, or the execution of the trust, will usually terminate the agency unless the authority is coupled with an interest. Upon the law of agency is based to a large degree the law of partnership.

Age of Chivalry, The, or **The Legends of King Arthur,** by Thomas Bulfinch, was published in 1858. More than 20 years after, an enlarged edition appeared under the editorship of

Edward Everett Hale. In Part First the legends of King Arthur and his knights are considered. Part Second deals with the Mabinogion, or ancient prose tales of the Welsh; Part Third with the knights of English history, King Richard, Robin Hood, and the Black Prince. From the time of its first publication the popularity of the book has been great. No more sympathetic and fitting introduction could be found to the legends of chivalry.

Age of Fable, The, or **The Beauties of Mythology,** by Thomas Bulfinch, was published in 1855, and republished in 1882 under the editorship of Edward Everett Hale. It has become a standard work upon mythology, by reason of its full and extensive treatment of the Greek and Roman myths.

Age of Reason, The, by Thomas Paine, was first published in a complete edition 25 Oct. 1795. In 1793 the First Part appeared, but no copy bearing that date can be found. Part First consists of an inquiry into the bases of Christianity, its theology, its miracles, its claims of revelation. The process is destructive and revolutionary. In Part Second the author makes critical examination of the Old and New Testament, to support the conclusions and inferences of Part First. Yet the work is not wholly negative. «The Word of God is the creation we behold.»

Ageratum, a-ger'a-tum, a genus of plants of the natural order *Compositæ* (belonging to the Eupatorium tribe of the order), natives of the warmer parts of America. One species, *A. mexicanum,* is an annual plant of flower borders and has densely clustered capitula of lavender-blue flowers. Several others are also grown in gardens, some of them with purple, white, or pale blue flowers. One of these, *A. conyzoides,* has sky-blue or gray-blue flowers and flower-heads almost conical in form. This species, with *A. littorale,* grows wild in southern Georgia, and in Florida.

Agesila'us, a king of Sparta: b. 442 B.C., and elevated to the throne after the death of his brother Agis II., in 398. Called by the Ionians to their assistance against Artaxerxes, he commenced his glorious career by defeating the Persians and defending Sparta against the united attack of Thebes, Corinth, etc. In a subsequent war with Thebes he had to contend against Pelopidas and Epaminondas, the greatest generals of those times. His prudence, however, saved Sparta without the hazard of a battle. He delivered it anew at the age of 80 years, though it was actually in the hands of Epaminondas. In the spring of 361 he crossed over to Egypt with a body of Lacedæmonian mercenaries, and there, after displaying much of his former ability, he died while preparing for his voyage home, in the winter of 361–360. Though small and insignificant in person he was a noble prince and almost adored by his soldiers.

Agglomerate, in geology, a name applied to a rock consisting of angular fragments of other rocks, united or bound together by a matrix of similar materials but of finer texture. The rock is of volcanic origin, but the fragments may be either volcanic or sedimentary, having been ejected from some volcano.

Agglutinate Languages, languages in which the modifying suffixes are as it were glued on to the root, both it and the suffixes retaining a kind of distinctive independence and individuality, as in the Turkish and other Turanian tongues. (See Max Müller's ‹Lectures on the Science of Language.›)

Agglutination. See IMMUNITY.

Aggregation, States of, an expression sometimes used to signify, collectively, the various physical states in which matter can exist. For ordinary purposes it is sufficient to distinguish two fundamentally different states of aggregation, the solid and fluid; fluids being further subdivided into liquids and gases. A solid body may be defined as one that is capable of resisting a considerable shearing-stress. It is important to note, however, that a true solid does not yield continuously to a small deforming force; it resists deformation, and its resistance increases as the deformation increases. A fluid, on the contrary, is a body having almost no shearing-strength, and offering very little resistance to forces that tend to change its shape. A fluid yields continuously to a deforming force, and a force that will deform it at all will deform it indefinitely, so long as it is allowed to act. Considering the subdivision of fluids into gases and liquids, it may be said that a gas is a fluid that presses continuously and in every direction on the walls of the vessel containing it, and which follows them indefinitely if they retreat. A gas, if left to itself, tends to expand infinitely in every direction. A liquid may be defined as a fluid which does not follow the walls of the containing vessel if they retreat, and which has no tendency to sudden and indefinite expansion when freed from all restraint.

These distinctions between the various states of aggregation in which matter occurs are to a certain extent arbitrary, elastic, indefinite, and inexact. For example, certain kinds of pitch resist the action of deforming forces that are applied for a short time only, and are brittle enough to fracture, like glass, under the influence of a sudden stress; yet they yield slowly but continuously to very small deforming forces, when those forces act for a long time. A body of this sort, strictly speaking, is neither a solid nor a liquid, and to include it in a general classification we should have to have a «semi-solid» division. The distinction between liquids and gases is even more artificial than that between solids and liquids; for a liquid may be made to pass into its vapor in such a manner that it is impossible to state at what moment it ceases to be a liquid. Thus, if water is heated under a sufficiently great pressure up to 700° F., and is then allowed to expand by a sufficient amount at this temperature, and is finally cooled at constant volume, we shall find, at the end of this operation, that it has been entirely transformed into steam, although we cannot say at what stage the transformation took place. See CRITICAL POINT; EQUILIBRIUM (*Chemical*); MOLECULAR THEORY; THERMODYNAMICS; MATTER.

Agincourt, ăj'in-kōrt, or **Azincourt,** ä-zhäṅ-koor, France, a village, dept. Pas-de-Calais, famous for a battle fought there 25 Oct. 1415. Henry V., king of England, eager to conquer France, landed at Harfleur, took the place by storm, and wished to march through Picardy

to Calais, in order to fix his winter quarters in its neighborhood. With a powerful force the Dauphin advanced against him. Henry V. retreated to the Somme. The French followed to harass his retreat and to defend the passage from Abbeville to St. Quentin, which he gained only through the inattention of the enemy. The English, however, being destitute of everything and reduced by sickness, Henry asked for peace on disadvantageous terms. The French refused his proposals, and succeeded in throwing themselves between Calais and the English. These latter consisted of 2,000 men-at-arms and 12,000 archers, and were arranged in order of battle between two hills, with the archers on the wings. Stakes, of which every man carried one, were fixed in front of them. The French, commanded by the Constable d'Albret, numbered 50,000 troops, of whom 8,000 were men-at-arms; but other estimates make the French strength much greater. They arranged themselves in two divisions, with the men-at-arms, of whom 2,000 were mounted, in front. The English first put themselves in motion. The French horse instantly hastened to meet them, but were received with such a shower of arrows by the archers that they fell back on the first division, and threw it into confusion. The light-armed English archers seized their clubs and battle-axes and broke through the ranks of the French knights, who could hardly move on account of their heavy coats of mail and the closeness of their array. The English horse rushed to assist the archers; the first French division retreated; the second could not sustain the charge of the victors; and the whole French army was soon entirely routed. The victorious army, in the pursuit of the flying enemy, took 14,000 prisoners in addition to those previously captured; 10,000 Frenchmen lay dead on the battle-field. Among them was the Constable of France, with six dukes and princes. Five princes, among whom were the Dukes of Orleans and Bourbon, were taken prisoners. The English lost 1,600 men killed; among them the Duke of York, Henry's uncle, whom the Duke d'Alençon slew at his side while pressing toward the king. D'Alençon had dashed the crown from Henry's head, and lifted his hand for a more effectual blow, when the king's attendants surrounded him and he fell covered with wounds.

Agis, ā'jis, the name of four Spartan kings. Agis I., son of Eurysthenes, founder of the family Agidæ, and reputed conqueror of Helos. Agis II., son of Archidamus II., and reigned either in 427 or 426 B.C. to 400 or 399 B.C. He was active in the Peloponnesian war; invaded Attica several times; and conquered the Athenians at Mantinea in 418 B.C. Agis III., son of Archidamus III., reigned in 338–1 B.C. He endeavored to overthrow the Macedonian power in Europe, but was routed and killed in a battle with Antipater in 331 B.C. The most important of the four kings was Agis IV., who succeeded to the throne in 244 B.C., and reigned four years. He attempted a reform of the abuses which had crept into the state — his plan comprehending a redistribution of the land, a division of wealth, and the cancelling of all debts. Opposed by his colleague, Leonidas, advantage was taken of his absence in an expedition against the Ætolians to depose him. Agis at first took sanctuary in a temple, but he was entrapped and hurriedly executed by his rivals.

Aglossa, ā-glos'sa (Gr. *a*, priv.; *glossa*, tongue), a group of the order *Anura* (toads and frogs) containing only two living families, the South American *Pipidæ* and the African *Xenopidæ*, and characterized by the lack of any tongue and the union of the eustachian tubes into one opening far back in the palate. The pipa toads and South African plathandlers are typical examples. The group is interesting for its antiquity and primitive relationships.

Agnadello, an-ya-del'lo, North Italy, a village 10 m. E. of Lodi, near which Louis XII. of France completely defeated the Venetians, on 14 May 1509, and the Duke of Vendome gained a victory over Prince Eugene in 1705.

Agnano, an-yä'no, till 1870, a small lake, 3 m. W. of Naples, about 60 ft. in depth, and without visible outlet. As it was supposed to cause malaria it has been drained. The surrounding country is volcanic and mountainous. On the right lies the Grotta del Cane, where the carbonic acid is dense enough to kill dogs, and on the left are found the sulphurous vapor baths of San Germano, which are valuable for gout and blood disorders.

Agnes, Saint, a saint who, according to the received account, because she steadfastly refused to marry the son of the prefect of Rome and adhered to her religion in spite of repeated temptations and threats, suffered martyrdom during the persecution of the Christians in the reign of the Emperor Diocletian, 303 A.D. She was first led to the stake, but as the flames did not injure her she was beheaded. Her festival is celebrated on the 21st of January. Domenichino painted a picture representing her at the moment of her execution.

Agnesi, â-nyā'sē, **Maria Gaetana,** a learned Italian lady: b. in Milan in 1718. In her 9th year she was able to speak Latin, in her 11th Greek; she then studied the Oriental languages, and next geometry and philosophy, mathematics having latterly engaged her chief attention. She was appointed, in 1750, professor of mathematics in the University of Bologna, ultimately took the veil, and died in 1799. Her sister, Maria Theresa, composed several cantatas and three operas.

Agnes of Sorrento, a romance by Harriet Beecher Stowe. The scene is laid in central Italy during the papacy of Alexander VI. (1492–1503). Agnes is the daughter of a Roman prince who secretly marries and then deserts a girl of humble parentage. The young mother dies of grief, and Elsie, the grandmother, takes Agnes to Sorrento, where she lives by selling oranges in the streets. Her beauty and her purity attract to her many lovers, worthy and unworthy, and involve her in many romantic and dramatic incidents.

Agnew, Cornelius Rea, an American physician: b. New York 8 Aug. 1830; d. 8 April 1888. Professor of diseases of the eye and ear in New York College of Physicians and Surgeons. He was a graduate of Columbia College, and later studied in Europe; was surgeon-general of the State of New York at the beginning of the Civil War, when he became medical director of the New York State Volunteer Hospi-

tal. As member of the United States Sanitary Commission he contributed largely to its success. In 1868 he founded the Brooklyn Eye and Ear Hospital. He was interested in the public schools of New York; became founder of the Columbia College School of Mines, and in 1874 one of the trustees of the college. His writings are chiefly monographs on diseases of the eye and ear.

Agnew, David Hayes, an American surgeon and medical writer: b. 24 Nov. 1818; d. 22 March 1892; for many years professor of surgery at the University of Pennsylvania. He was also the operator in several important cases, notably that of President Garfield. He published 'Practical Anatomy' (1867); 'Anatomy and Its Relation to Medicine and Surgery'; 'Principles and Practice of Surgery' (1878); etc.

Agno, ag'nō, an important river in the N.W. part of Luzon, Philippine Islands. It is about 90 m. in length, describing a circuitous course, parallel with a range of coast mountains, and emptying into Lingayen Gulf. The town of Lingayen is at the mouth of the river, which is accessible by railway from Manila.

Agnosticism (Gr. "unknowing"), a school of thought which holds that man can know nothing of ultimate realities, or whether they exist; since, his only means of knowledge being through comparison of phenomena, the absolute could only be cognized by his senses on assuming phenomenal traits, and would then be grasped as a phenomenon and not as absolute, the knowledge of which is therefore a contradiction in terms. We cannot know anything outside our own mental processes and the existence of other minds; in popular phrase, we cannot get behind the looking-glass. This does not, however, deny the absolute any more than affirm it; and most agnostics (as Clifford, one of the greatest) consider the diversity of phenomena as probably indicating a diversity in their causes. The agnostic position involves refusal to accept "evidences" of the origins of the universe, of unseen powers, of a future life, or in general the metaphysical bases of religion, save as more or less probable inferences. The current idea that it involves rejection of these beliefs, however, is entirely wrong: the agnostic does not admit that either the affirmative or the negative of them can be a subject of knowledge, and regards the atheist as less intellectually respectable than the devotee. In point of fact, Prof. Huxley, the inventor of the term, thought the existence of beings higher than man rather probable than otherwise, and the government of the universe by a "divine syndicate" of great spiritual essences quite logical. The greatest of modern agnostics was Herbert Spencer. The theory is practically that of the Pyrrhonist or Skeptical school of Greek philosophers.

Agnus Dei. See SACRAMENTALS.

Agosta, or **Augusta**, a seaport on the S.E. coast of Sicily, in the province of Syracuse, and 12 m. N.N.W. of the city of that name. It was a place of some importance before the earthquake of 1693, which buried a third of the inhabitants in its ruins, and at the same time by supposed sulphurous vapors which issued from the ground, ignited the powder magazine, and blew up the citadel. It was off this port that De Ruyter, the famous Dutch admiral, in command of the united Dutch and Spanish fleet, 22 April 1676, was defeated by the French under Duquesne, and received his death wound. Pop. about 12,500.

Agra, ä'gra, India, a city in the Northwest Provinces, on the right bank of the Jumna, 841 miles by rail from Calcutta. It is a well-built and handsome town and has various interesting structures, among which are the imperial palace, a mass of buildings erected by several emperors; the Moti Masjid or Pearl Mosque (both within the old and extensive fort); the mosque called the Jama Masjid (a cenotaph of white marble); and above all, the Taj Mahal, a mausoleum of the 17th century, built by the Emperor Shah Jehan to his favorite queen, of white marble, adorned throughout with exquisite mosaics. There are several Protestant and Roman Catholic churches, a government college, and three other colleges or high schools, besides a medical college. Agra has a trade in grain, sugar, etc., and some manufactures, including beautiful inlaid mosaics. It was founded in 1566 by the Emperor Akbar, and was a residence of the following emperors for over a century. Pop. 168,662. The Agra division has an area of 10,139 square miles, and a pop. of 4,767,759.

Agrarian Laws, enactments framed at different times by the Romans to regulate the public domain. In the first epoch of the growth of Rome, before the city had extended beyond the Palatine Hill, the whole soil of the state was undivided public property, and from the state, consisting exclusively of citizens, every citizen received a share for his private use. In principle all the land was therefore undivided public property, and the citizen could only acquire possession as tenant at will of the state. In course of time, however, the descendants of the original founders, or the patricians, transformed these primitive concessions into an absolute right called in the Roman law *de jure quiritio*. During the entire existence of the republic the principle was recognized that all lands and personal property acquired by conquest were acquired for the state, and could only become the property of individuals through the cession to them of the rights of the state. As conquest increased the public property, and the class of plebeians was formed, the Roman government gave them an interest in the public domain as private property on condition of their paying a tribute and undertaking other public services. The patricians, however, always preserved their ancient right of receiving in possession and using portions of the public property on paying to the public treasury a tithe of its product. From the earliest period of Roman history lands thus held could pass as an inheritance to children, and were even sold under this uncertain tenure, while the state always reserved the power to resume possession. Spurius Cassius, a patrician, on becoming consul in the early period of the republic, caused a law to be enacted that some portion of the public lands, long before conquered, but occupied by the Roman nobles, should be surrendered to the state and assigned to the needy citizens. The law remained a dead letter because of the resistance of the patricians, who not only prevented any new divisions of the public lands, but by violence or usury acquired

those of the plebeians. The keeping of large flocks of cattle practically ruined the common pasture lands, and in fact excluded the small farmers from them. This caused the publication, in 367 B.C., of the Licinian law, so called from Licinius Stoto, its originator. For a brief period this law was put in force, after which it was neglected for nearly 200 years, when it was renewed by Tiberius Gracchus with some additions and modifications in favor of the patricians. The attempt to execute these laws caused the death of the two Gracchi (133 and 121 B.C.). Not one of the Agrarian laws was ever executed, and it is said by the ablest writers that they had none of that leveling and confiscatory character which has been so often attributed to them. It is believed by able writers that none of the laws aimed at the equal division of real estate owned by individuals in their own absolute right, or intended any limitation upon the ownership of land. The most prominent advocates of the Agrarian laws, Cassius, Licinius, and the Gracchi, all belonged to the class which would have been injured by their operation had they led to an undue interference with the right of private property.

Agrarian Party, a political organization in Germany, representing the interests of the landlords (in political life). The first steps toward the formation of the party were taken by an assembly called together at Breslau, in May 1869, by M. A. Niendorf (d. 1878), and Elsner von Gronow, but the theory on which the party was based had already been formulated by Johann Karl Rodbertus. The organ of the party was *Die Deutsche Landeszeitung*, edited by Niendorf. In February 1876 a constitutional assembly of agrarian reformers was opened, and adopted the official name of "Steuer und Wirtschaftreformer." Their programme was especially devoted to the abolition of taxes on land, buildings, and trades. At first especial emphasis was laid on free trade, but this object fell more and more into the background after 1879. Since that date they have sought to limit the importation of food stuffs, and have opposed several commercial treaties supported by the government; they have also opposed the emperor's project for a canal system, and have been hostile to his navy policy. As the Agrarians dominate the Conservatives in the Reichstag they have frequently obtained important concessions in commercial matters and forced the government to turn to the Radicals for support for its measures.

Agreement, a mutual bargain, contract, or covenant. Agreements may be either express or implied. Express agreements are those openly stated and avowed by the parties at the time of their making. Implied agreements are those which the law supposes the parties to have made although the terms were not openly expressed.

There must be an agreement by the parties, a definite offer made by one party and accepted by the other, and they must assent to the same thing in the same sense. The assent must be mutual and obligatory, and there must be a request on one side and an assent on the other. The assent must be broad enough to cover the whole proposition. It must be exactly equal to its extent and provision, and it must not qualify them by any new matter, and even a slight qualification destroys the assent. The agreement must be based upon a sufficient consideration (q.v.), and as against third persons this consideration must be good or valuable. It need not be adequate provided it has some real value. If the consideration is impossible, or illegal either in whole or in part, the agreement will be void. The agreement may be to do anything permitted by the law, as to sell and buy real estate or personal property. The evidence of the sale of real estate, however, must be by deed, and sealed. In many instances agreements in regard to personal property must be reduced to writing. See CONTRACTS.

Agric'ola, Cneius Julius, lived from A.D. 37 to 93, and was a Roman general and governor in Britain, the greater part of which he brought under the dominion of Rome. His life (which extended through the reigns of the nine emperors from Caligula to Domitian) has been excellently written by his son-in-law, Tacitus, who holds him up as an example of virtue. Agricola was born at Forum Julii (now Fréjus in Provence), and was the son of Julius Græcinus, a senator put to death under Caligula. He served his first campaign in Britain in 60, and after serving in Asia Minor and again in Britain, and governing Aquitania as prætor for three years, he was raised to the consulship in 77, and the next year went to Britain as governor. Agricola was the twelfth Roman general who had been in Britain, but was the only one who effectually subdued it; partly by his consummate military skill, partly by his policy in reconciling the Britons to the Roman yoke, and by teaching them the arts and luxuries of civilization. In his fourth campaign he built a chain of forts between the Forth and Clyde to help to keep in check the peoples to the north of this. His seventh and last campaign (A.D. 84) was marked by the total defeat of the Caledonians under Galgacus, at some place called by Tacitus *Mons Grampius* or *Graupius*. In this campaign his fleet sailed northward from the coast of Fife round Britain to the Trutulensian harbor (supposed to be Sandwich), thus for the first time proving that the country was an island. His death was either caused or hastened by the minions of the jealous tyrant Domitian.

Agricola, Johann, German reformer: b. 1492; d. 1526. He was one of the most active among those who propagated the doctrines of Luther. He studied at Wittenberg and Leipsic; was afterward rector and preacher in Eisleben, his native city, and in 1526, at the Diet of Spires, was chaplain of the Elector John of Saxony. He subsequently became chaplain to Count Albert of Mansfield, and took a part in the delivery of the Confession of Augsburg, and in the signing of the articles of Schmalkalden. When professor at Wittenberg, whither he went in 1537, he stirred up the Antinomian controversy with Luther and Melanchthon. He afterward lived at Berlin, where he died after a life of controversy. Besides his theological works he composed a work explaining the common German proverbs. Its patriotic spirit, strict morality, and pithy style, place it among the first German prose compositions of the time, by the side of Luther's translations of the Bible.

Agricola, Rudolphus, the foremost scholar of the "New Learning," in Germany: b. 23 Aug. 1443, near Groningen, in Friesland; d. 28 Oct. 1485. His real name, Roelof Huysmann (husbandman), he Latinized into Agricola; and from his native place he was also called Frisius, or Rudolf of Groningen. From Groningen he passed to Louvain, then to Paris, and then to Italy; where, during the years 1473–80, he attended the lectures of the most celebrated men of his age, and where he entered into a close friendship with Dalberg, afterward Bishop of Worms. On his return home he endeavored, in connection with several of his former co-disciples and friends, to promote a taste for literature and eloquence. Several cities of Holland vainly strove with each other to obtain his presence, but not even the brilliant overtures made to him by the Emperor Maximilian, to whose court he had repaired in connection with affairs of the town of Groningen, could induce him to renounce his independence. At length yielding (1483) to the solicitations of Dalberg, he established himself in the Palatinate, where he sojourned alternately at Heidelberg and Worms, dividing his time between private studies and public lectures, and enjoying high popularity. He distinguished himself also as a musician and painter. With Dalberg he revisited Italy (1484), and shortly after his return died at Heidelberg. Most of his works were collected by Alard of Amsterdam (2 vols. Cologne, 1539).

Agric'olite, a mineral having the same composition as eulytite, but crystallizing in the monoclinic system. It also occurs in globular forms, with a radiated structure, and the crystals, when they occur, are indistinct. The species needs further examination.

Agricultural Ant, a remarkable species of ant (*Myrmica molefaciens*) that cultivates fields of grass around its hill, allowing only one kind of grass (*Aristida*) to grow in a field; it harvests the seeds and stores them away as food. The fields may be as large as 15 feet across; roads are laid out from the hill to the outer margin of the plantation, so that the crop may not be trampled, and any weeds which appear among the grass blades are at once cut off. These colonies are often found in large grain fields, which they injure in proportion to their numbers.

Agricultural Chemistry is the science upon which scientific agriculture is built; the chemistry of the atmosphere, of the soil, of manures, of plants, and of animals, describe and explain in large part the phenomena of plant growth and of the transformation of plants into animal products. The basic facts which the investigations of agricultural chemists have revealed, and which serve as the foundation upon which the facts derived from further investigation must rest, may be stated as follows:

Sources of Plant Food.—The atmosphere and the soil are the two sources from which plants obtain their food. The atmosphere supplies the plant, either directly or indirectly, with carbon, hydrogen, oxygen, and nitrogen; the carbon mainly directly in the form of carbon-dioxid, the hydrogen and oxygen indirectly in the form of water in the soil, which is absorbed by the roots of plants, and nitrogen mainly indirectly in the form of nitrates in the soil, which is also taken up by the roots of plants. The soil is the only source of the mineral elements used by the plant, and those essential for its growth are potassium, magnesium, calcium, iron, chlorine, sodium, phosphorus, and sulphur, though others may be present in the plant as accidental salts; as, for example, silicon, manganese, boron, etc. These mineral elements are obtained from the soil by means of the plant roots.

Constituents of Manures.—While plants require and use a relatively large number of chemical elements for their perfect development, those essential in manures are limited to four, namely, nitrogen, phosphorus, potassium, and calcium, for the reason that these are contained in the soil in relatively small amounts, and are required by plants in relatively large amounts. Exhaustion of soil means the exhaustion of one or more of these four constituents, which measure the potential fertility, and a direct manure is a substance which contains one or two, or all of these.

The Composition of Plants.— In all normal plant growths there are four distinct classes of substances, namely, albuminoids, fats, carbohydrates and mineral salts, each of which as a class exercises a special function in the nutrition of animals. The varying proportions of these substances in the different plants also determine the value of any plant as a source of any specific substance for commercial purposes; as, for example, sugar or oil.

The Composition of Animals.—The animal body consists of three classes of substances, namely, nitrogenous matter, fatty matter, and mineral salts; these are derived from, and are similar in character to, the same classes of substances in plants. These statements of the basic principles of plant growth and use clearly indicate the important role that agricultural chemistry may exercise in the many directions in which it may be applied in the development of scientific farm practice. It indicates the broad field of agricultural chemistry; and agricultural chemists, because of the many important special lines of inquiry, are classified as soil chemists, fertilizer chemists, food chemists, sugar chemists, agricultural industrial chemists, etc., according as they give special attention to any one of these particular branches.

Methods of Analysis.—The application of chemistry in these various directions, has in recent years been accompanied by a development in analytical and research methods, both in the devising of new apparatus and new methods for the analyses of new materials, and in the improvement of the apparatus and the methods already in use.

The Association of Official Agricultural Chemists, organized in 1880, which at first included only the American chemists engaged in the official analytical control of commercial fertilizers, gave the initial impetus to a movement which has been largely responsible for the progress of agricultural chemistry in this country. This organization has gradually broadened its work, and now includes, as members, analysts and specialists in all the various lines of agricultural chemical work. To this association is reported annually the investigations that have been made by its members in the testing of new

and in the improvement of old analytical methods. The good results of such work are particularly noticeable in the adoption of uniform methods in the different laboratories, either new, or modifications of those standard methods devised by the earlier investigators. The crude apparatus and the tedious methods of 25 years ago, which are still in use in many foreign laboratories, have in this country been supplanted by those which ensure not only greater accuracy, but greater rapidity of execution. These improvements have made it possible for the chemists to perform the large number of analyses now required in the official control of commercial fertilizers, of commercial foodstuffs, and of dairy products.

The Study of the Sources of Nitrogen to Plants.— The most important contribution made to science by agricultural chemists in recent years has been in the study of the sources of nitrogen to plants. The experiments of Berthelot, Helriegel, Wilfarth, and others in Europe, and of Atwater in America, have modified the views originally held in reference to this subject. That the chief source of nitrogen to plants is mainly directly from the soil in the form of nitrates is not disputed, but the experiments referred to have shown that the leguminous plants, such as peas and beans, have the power of obtaining the free nitrogen of the air, and thus both soil and air contribute to their supply of this element. It has been shown that this absorption of free nitrogen is not performed directly, but the fixation is the result of the joint action of certain micro-organisms present in the soil and in the plant itself; that this fixation is connected with the formation of tubercles on the roots of this class of plants, and that these may be the home of the fixing organisms, which are not present in all soils. In other words, the fact has been established that these plants do obtain their nitrogen from the air, a source inaccessible to other classes of plants, though the exact method and the complete phenomena involved in its appropriation are not yet understood; these points are matters under investigation at the present time.

Denitrification.— Denitrification, or loss of nitrogen from soils and manures by the reduction of the nitrates and the setting free of the nitrogen, is another rather new though closely related phase of the nitrogen question which is receiving the attention of agricultural chemists. Denitrification is also due to organisms contained in manures and in soils, and the question involves the study not only of the organisms themselves, but of their food and the conditions which favor or retard their growth. The experiments conducted thus far both in Europe and in America indicate that good conditions of soil management do not favor the activity of these organisms, and that losses due to denitrification are greatest where drainage, cultivation, and management are neglected.

Chemical Investigation of Soils.— Chemical investigations have shown that the active fertility of soils depends both upon the amount of the essential constituents present, and the mutual reactions of the various classes of substances which constitute their bulk. Chemical studies have been directed toward separating these substances, and to the discovery of their relations to each other. The combined study of the influence of the chemical and physical properties of soils in encouraging changes in the chemical form of the constituents, and in their absorptive and retentive power for both water and plant-food, has resulted in showing the adaptation of certain classes of soils to specific crops, and has made it possible to indicate clearly the line of profitable culture.

Further important results of studies in recent years have had their origin in the discovery that micro-organisms living in the soil exert a decided influence in changing its chemical character, and in contributing to active fertility. It has been established that, other things being equal, soils are fertile in proportion as the physical and chemical conditions are favorable for the growth and development of those living forces. This fact has encouraged the chemical study of the various classes of soil substances as sources of supply of food for these lower organisms, and the knowledge gained has contributed materially to the development of methods of soil improvement.

Farm Manures.—The question of the function of natural agencies in promoting fertility is closely related to that of manures, fertilizers, and soil amendments. Chemical studies of the character and value of farm manures as sources of plant food, of the source of loss of the valuable constituents, especially nitrogen, contained in them, and the methods of preservation and use of the various materials, have established the important facts that practically 80 per cent of the fertility elements contained in food are found in the manure, and that more than one half of the nitrogen and practically all of the potash contained are in soluble forms. These constituents are readily available as food to plants, comparing favorably with best artificial supplies, but are liable to suffer great loss, the former by fermentation and leaching, and the latter by leaching. This may be prevented by proper care and the use of preservatives.

Fertilizers.— As to the artificial supplies of plant-food, chemical studies have been mainly directed toward the determination of the availability of the different constituent elements contained in the various sources of supply. Nitrogen, for example, shows varying degrees of availability: with nitrate at 100 per cent as a basis, the range is from 80 per cent in dried blood to as low as 2 per cent for leather. These wide variations in agricultural value are not accompanied by variations in commercial value, hence studies have been made of chemical methods for the determination of the availability of nitrogenous substances in mixed fertilizers, in which it is otherwise impossible to detect their source, and such progress has been made as to enable chemists by the use of these methods to indicate the relative value of the materials used. Much study has also been given to the question of the relative availability of the phosphoric acid as found in the various raw and manufactured supplies, and positive information can now be given as to the best sources of supply for specific crops and for special kinds of soil.

Lime, Marl, and Other Soil Amendments.— The purpose of the use of these materials is mainly to supply the plant indirectly with its needed constituents, and careful investigations have shown that lime, for example, while not usually a deficient constituent, performs very

important functions in the improvement of soil: first, in correcting acidity, and thus making the soil a better medium for the growth and development of soil organisms; second, in acting chemically on organic matter and on phosphatic and potash compounds in the soil, and setting free their constituent elements; and third, in changing and improving the physical character of soils. Notable studies along this line have been carried out in this country, particularly by Wheeler in Rhode Island, and the results of such investigations have done much to promote the growth of leguminous crops, which add to the soil humus-forming material containing nitrogen; the humus exerting an important function in increasing the absorptive and retentive powers of soils.

The Composition and Nutritive Value of Plants.— Recent chemical investigations have also resulted in securing more definite information concerning the approximate composition of plants. It is now possible to classify clearly the nutritive substances contained in any specific crop, and to determine the composition of the various chemical substances in the same group. In the group albuminoids, for example, methods of analysis have been developed which enable a separation of the various nitrogenous bodies contained in it, and which show their relative nutritive value. Very important studies of this group have been carried out by Osborne in Connecticut: those in the use of the respiration apparatus, in the studies of human nutrition, by Atwater, and of animal nutrition, by Armsby, have already contributed materially to our sum of knowledge concerning the energy value of various nutritious bodies. These results have their application in the utilization of wastes and in the selection and preparation of rations and of dietaries, furnishing a rational basis for the selection, combination, and preparation of foods.

The Chemical Improvement of Plants.—The improvement of plants, not only for use directly as food, but as sources of supply of specific compounds for special manufacture, has been very marked in recent years. The chemical study of the sugar-beet, of sugar-cane, and of sorghum, has resulted in the development of varieties which are much richer in sugar than formerly, and poorer in non-sugars, the substances which interfere with the extraction and crystallization of the sugar. So also the chemical study of maize, combined with the selection of seed, has enabled the building up of varieties which possess a larger than normal proportion of either carbohydrates, the fats, or the nitrogenous matter, thus improving this most useful plant for the purpose of the manufacture of starch or as a source of oil, or for use as food for live stock. The increase in the gluten content of wheat for the flour manufacturer, the improvement of barley for the brewer, are also the direct result of chemical supervision in the growth of these plants.

The Chemistry of Dairy Products.— The agricultural chemist has also been active in the study of the composition and character of the milk of different dairy breeds as sources of food supply, as well as the processes involved in the manufacture of butter and cheese. Quick and accurate methods for determining the percentage of the important constituent fat have been developed, and valuable results have been secured in the study of the changes that take place in the manufacture of cheese. The most important recent discovery is that of Russell and Babcock of Wisconsin, that enzymes cause the breaking down of the nitrogenous bodies of the milk, and that they, together with bacteria, are factors to be considered in the curing of cheese.

History.— As a science it was born only a century and a quarter ago. The composition of the soil was then unknown, and its relation to plant-growth, with the true function of fertilizers, a matter of crude and blundering empirics. It is interesting to note that Lavoisier, who did so much to create the general science, formulated also its agricultural application with striking accuracy, saying that the components of plants « in the last analysis are drawn from the air and the mineral kingdom. On the other hand, fermentation, putrefaction, and combustion continually restore to these the principles borrowed from them by plants and animals.» Sir Humphry Davy, following Lavoisier's indications with zeal, was the first great chemist to make agricultural chemistry a special study and write upon it, delivering a course of lectures before the British Board of Agriculture about 1800, and embodying them in a volume. Many of his hypotheses were erroneous, but he greatly advanced the science.

As early as 1807 Count Rumford observed that plants deprived of carbonic acid die; and soon afterward Ingenhousz proved that they absorb it only under the influence of sunlight. These facts led to the great generalization, the basis of scientific agricultural chemistry, that plants live mainly on inorganic matter.

During the second quarter of the century the distinguished French chemist Boussingault devoted himself almost wholly to agriculture, publishing many papers on it, his ‹Rural Economy› (1844) giving him a European reputation; and the second De Saussure (d. 1845) wrote 36 valuable papers on vegetable physiology, collected as ‹Chemical Researches on Vegetation.› But the great era in the science was made by Justus von Liebig, who published in 1840 a famous work entitled ‹Organic Chemistry in its Relation to Agriculture,› translated into several languages and of enormous influence. He had great gifts of exposition; and he established in the popular mind the theory of the plants' almost entire dependence on mineral food, hitherto held only by a few men of science. Further, his researches founded artificial fertilization — that is, the use of chemically-prepared fertilizers; and showed how to make the phosphoric acid in mineral phosphates available by treatment with sulphuric acid. He also demonstrated the value of potash as plant food. He taught that the nitrogen was absorbed solely as ammonia: a view much modified by later researches.

The publication of his experiments made a profound impression, and paved the way for the establishment of experiment stations (q.v.), and in the United States led to the formation of the Agricultural Division of the Patent Office, since developed into the Department of Agriculture.

The work of Pasteur showed that fermentation was due to living organisms, thus revo-

lutionizing the whole theory of organic decay. One important practical application of this discovery was the possibility of preserving food by heat sterilization.

Liebig's theory of nitrogen assimilation by plants was fully demolished only by the discoveries of a few years ago, consequent on Pasteur's, that the proteid matter furnishing the bulk of nitrogenous plant foods is changed by ferments successively into ammonia, nitrous acid, and nitric acid, in which form it is directly assimilated.

As the nitrogenous foods are far the most expensive of all essential manures this discovery is vital to agricultural progress. The Chilean and other South American stores of nitrates are not inexhaustible, and hence every means of increasing the nitrates in the soil is of the first importance. A promising method is to convert atmospheric nitrogen into nitric acid by electricity; electric storms do this in trivial quantities, as detectible in rain-water, but the marvelous recent growth of electrical invention now accomplishes it by dynamos.

In the development of agricultural colleges and experiment stations chemistry has always been the leading science: of the present directors of United States stations 21 were professional chemists when appointed; in Europe the proportion is even greater.

In the valuable feature of scientific bulletins from the experiment stations, Prof. F. H. Storer of Bussey Institute led the way. But perhaps the most successful popularizer of the science since Liebig was Samuel William Johnson, appointed agricultural and analytical chemist at Yale in 1857, whose books, ‹How Plants Grow› and ‹How Plants Feed,› have been more universally read in this country than any other agricultural works. Another powerful early worker was E. W. Hilgard of the University of California, whose work on soils is a classic. At Cornell, from its opening to the present, George C. Caldwell has held the chair of agricultural chemistry with distinction. Others of note are C. A. Goessmann of the Massachusetts Agricultural College, and the late R. C. Kedzie of the University of Michigan. These pioneers are worthy of remembrance for laying broad and deep the foundations of future agricultural progress.

The Association of Official Agricultural Chemists is by act of 1902 the adviser of the secretary of agriculture in fixing United States food standards.

This science has been important in developing the great manufacturing industries dependent on agricultural products, as of cane and beet sugar, starch, beer, wine, and distilled liquors. The fertilizer industry, opening up vast new stores of plant food,— as the vast phosphate deposits of the United States, the deposits of Stassfurt, Germany, and the nitrate beds of Chile,— is wholly created by agricultural chemistry. It also labors to increase the value of crops for given purposes without increasing their draft on the soil by studying the environing conditions which modify its chemical composition, and investigates the nutritive value of the plant foods so as to produce the most economical results from the raw material. It teaches the best methods of utilizing such foods and of conserving them for the future, develops new staple crops, and opens up new avenues of prosperity.

Bibliography.— Armsby, ‹Manual of Cattle Feeding›; Blyth, ‹Foods, Composition and Analysis›; Greiner, ‹Practical Farm Chemistry›; S. W. Johnson, ‹How Crops Feed,› and ‹How Crops Grow›; Lloyd, ‹Science of Agriculture›; H. Richmond, ‹Dairy Chemistry›; S. Riedeal, ‹Sewage›; Storer, ‹Agriculture in Some of Its Relations with Chemistry› (3 vols.); United States Department of Agriculture, publications of the Bureaus of Soils, Chemistry, and Plant Industry; The Office of Experiment Stations, ‹Food and Nutrition of Man,› and the publications of the American Experiment Stations; Voorhees, ‹Fertilizers›; Wahnschaffe, ‹Scientific Examination of Soils›; Warrington, ‹Chemistry of the Farm›; Wiley, ‹Principles and Practice of Agricultural Analysis› (3 vols.).

E. B. VOORHEES,
Director New Jersey Agricultural Experiment Station.

Agricultural Colleges. As a result of national and State co-operation, which enables the ordinary farmer to profit from the experiments of widely separated individuals interested in scientific farming, the United States stands foremost in the matter of agricultural development. Our Department of Agriculture renders the greatest service imaginable to the country; but its facilities are greatly improved by the co-operation of the different State agricultural institutions, while the farmers of each section can rely upon their special State colleges to supplement the work of the national institution.

The Massachusetts Agricultural College is one of the foremost representatives of the typical institution devoted to practical agricultural education, and its work and studies are devoted chiefly to the training of students in modern scientific farming. The work is conducted both in the class-room and on an experimental farm. The institution is located on a farm of 400 acres at Amherst, and its buildings and land are valued at $315,000. Its annual income from the State and United States amounts to $45,000, and it is provided with a permanent endowment fund of over $350,000. There are buildings for nearly every imaginable specialty pertaining to agriculture — a chemical laboratory, botanical laboratory, plant-house, creamery and dairy laboratory, veterinary buildings, barns, museum, library, and entomological laboratory and insectary.

Instruction is given by a corps of 18 professors and assistants in chemistry, botany, agriculture, horticulture, zoology, veterinary science, mathematics, civil engineering, and similar studies. Practical work on the farm is a part of the course, and the students cultivate the whole farm, experimental orchard, and nursery. There are 100 acres devoted to orchards, vineyards, and the cultivation of small fruits; 150 acres under cultivation with field crops, and nearly as many more allotted to grass and hay for the 100 head of cattle which are kept on the farm. Considerably over 1,000 men have been educated at the Massachusetts Agricultural College. A recent census of them showed that nearly 400 are

to-day engaged in agricultural pursuits; more than a score are instructors in other similar institutions; and others have drifted into a variety of callings. The effect of the college on the agriculture of the country must prove of immeasurable value if a similar proportion of its graduates adopt farming for their life's work, and perform their labors in a scientific manner, as they were taught to do at the institution.

The State agricultural and mechanical colleges which have sprung up in most of the leading agricultural States of the East and West, and in many parts of the South, in recent years, have in view the training of young men for scientific and practical agriculture, and also for mechanical and manufacturing arts and sciences. They are endowed by the State, and also by private individuals. They are for the most part under the control of the State Board of Agriculture, the governor, and other State officers; but the president and faculty of each institution practically have all the liberty they demand in carrying out the work according to well-defined policies. Some of these State agricultural colleges are remarkably well equipped and endowed for the work they have in hand. Thus, the Iowa State College of Agriculture has 15 buildings, which have been erected by the State at a total cost of $500,000. There are nearly 1,000 acres of land attached to the institution. A corps of 55 professors and nearly 600 students is engaged in study and work. All kinds of crops raised in Iowa are cultivated on the farm, and cattle, horses, and poultry are kept by the students. Experiments are constantly being carried on by the professors and students in agriculture, horticulture, chemistry, and general farming, and the results of these experiments are published in bulletins and papers for the benefit of the world.

The Pennsylvania State college, called the Agricultural College of Pennsylvania, is even broader in its educational aims than the Iowa college. Almost all studies from agriculture, chemistry, physics, engineering, mining, and mathematics up to philosophy, general literature, and languages are taught there. In recent years this college has steadily broadened as a high-grade technical, scientific, and classical institution. Nevertheless agriculture, in all its wide fields of application, is one of the chief studies emphasized at the college. A correspondence course has in late years been organized for the purpose of instructing students on farms who cannot attend the college, but who wish to avail themselves of the researches and facts obtained at it. Forestry is one of the most useful branches of work carried on at this college; and it not only trains young men to appreciate the value of cultivating orchards and woods, but also turns out practical foresters, capable of taking charge of large forests and converting them into profitable possessions, without destroying and denuding them of trees.

The Michigan State Agricultural College is another institution which, for more than 40 years, has endeavored to help the farmers in their struggle to wrest from the soil a fair compensation for their labors. The original idea of this college was to perfect in their studies all graduates of the common schools who wished to possess a complete practical and theoretic knowledge of the arts and sciences which bore directly upon agricultural and kindred pursuits. Economic zoology, meteorology, physics, veterinary science, entomology, bacteriology, chemistry, geology, and agriculture and horticulture are a few of the studies pursued. Post-graduates can pursue advanced studies in the sciences, and in the library of 20,000 volumes they can find nearly all the literature of value pertaining to their particular studies. There are some 676 acres of land attached to the college, 230 acres of which are devoted to field crops, 45 to woodland, 114 to orchards and garden, 47 to experimental fields, and 240 to forest. There is a fine arboretum, a botanic garden, a grass-garden, and a weed-garden, where 100 or more noxious weeds are grown to show their destructive possibilities to the students. There are some 450 students at the college, and more than half of them take the full agricultural course.

The South has a good institution of this class in the Mississippi Agricultural and Mechanical College, with a faculty of some 24 members, and a student membership of nearly 400. The college is under the management of a board of trustees, with the governor of the State an *ex officio* member. The students who attend this college are paid eight cents per hour for their work in the fields or orchards, which enables them to pay for a part of their living while studying.

The Kansas State College, with its 300 acres of land, buildings valued at $350,000, and a faculty of 45 professors and assistants, has become an important factor in the middle West in developing the agricultural possibilities. Agriculture, engineering, and general and household economics are taught to the students. There is a dairy, blacksmith-shop, foundry, machine-shop, printing-office, and woodwork and painting shop connected with the college, where practical work can be followed by the students.

With agriculture as our leading industry, many of the large universities have in recent years established an agricultural course and experimental farms for work in the regular college course. When this subject is mentioned, one turns instinctively toward Cornell University, with its admirable agricultural and forestry departments; toward the Ohio State University, with its buildings and equipments aggregating nearly $3,000,000 and with an income of $350,000; or toward the University of Wisconsin, or the University of California. These typical universities, which have given agriculture and horticulture a prominent place in their curriculums, send forth annually hundreds of students to teach practical farming to new communities which may still labor under the disadvantage of old methods and ideas of agricultural production. The Ohio State University at Columbus has over 1,000 students, and a corps of 78 professors and assistants; but it aims to give a scientific and classical education to both young men and women. It is divided into six colleges, with one devoted to agriculture and domestic science, and another to veterinary science. Students pursuing other studies can take courses in these departments, and there are also opportunities for graduate studies in the science of agriculture. There is a well-stocked farm of 200 acres connected with the university, a dairy department, a large laboratory for student work

in soils and crops, and a veterinary laboratory and operating building.

In the University of Wisconsin, with its membership rapidly approaching 2,000, and a corps of over 130 professors and assistants, there is a college of agriculture, which gives excellent courses in dairying, veterinary science, experimental farm work, entomology, scientific plant investigation, and general horticulture and agriculture. There are cheese factories, creameries, and dairies on the farm, with large greenhouses for raising plants, extensive barns for cattle, and bacteriological laboratories. The college co-operates with the 60 or more State institutes of the farmers in supplying literature and lecturers, and thus becomes an essential part of the State's chief industry.

Like the two former, the agricultural college of Cornell University, in New York, has become one of the greatest factors in stimulating and broadening the farming interests of the State and indirectly of the whole country, while it has contributed largely to the establishment of agriculture on a firmer and higher scientific basis than ever before in its history.

Agricultural Education. The earliest farmers in America had to contend with innumerable and great obstacles; with the wildness of nature, the attacks of Indians and wild beasts upon their stock, the difficulty of obtaining farming implements and seeds, and with conditions of climate and soil, very different from those of the old countries whence they derived all their methods. The colonial farmer was compelled to use the crudest methods. He cut down, heaped and burned the small trees and undergrowth, and belted the large ones. He scratched the surface a little with a home-made plow, and cultivated his corn and tobacco with a wooden hoe. He harvested the crop that nature gave him in a careless manner and used it wastefully. He cultivated the same field until it was worn out, when he cleared another and moved his family near to it. So long as land was so abundant, no attention was paid to the conservation of fertility of the soil. America was such a vast and fertile country that it took the people over a century to find out that there was any limit to its productiveness. These conditions were quite sufficient to explain the slow progress made in agriculture during the 1st century or more after the settlement of America.

It was not until the close of the 18th century that the attention of practical men commenced to be directed to the discoveries of science, and hopes were excited that immediate benefits would accrue from them to agriculture as they had to the other arts. Lavoisier's discoveries and teachings had aroused the hope that chemistry could do a great deal to promote the advancement of farming. Americans commenced to appreciate their disadvantages as compared with British and continental farmers, and to seek better implements and methods for their work. The newly awakened interest in agriculture was marked first by the formation of agricultural societies. George Washington was one of the best technically educated men in America in his day, and was especially interested in everything pertaining to agriculture. His various State papers show that he not only knew the needs of the country, but that he fully realized that schools for the education of the people and societies for the distribution of knowledge were necessary for the safety of the republic. A few extracts will recall his strong opinions on this subject. In his first annual message to Congress (8 Jan. 1790) he expressed the hope that the "advancement of agriculture, commerce, and manufactures, by all proper means, will not, I trust, need recommendation." and adds, "Nor am I less persuaded that you will agree with me in the opinion that there is nothing which can better deserve your patronage than the promotion of science and literature. . . . Whether this desirable object will be best promoted by affording aids to seminaries already established, or by the institution of a national university, or by any other expedients, will be well worthy of a place in the deliberations of the legislature." Notice how agriculture and a national university for the promotion of science and arts were always associated in Washington's mind. He mentions the advancement of agriculture and the establishment of a national university in the same connection in his first message. He discusses them together in many of his writings during eight years, and finally in his eighth annual message, he says, "It will not be doubted that with reference either to individual or national welfare agriculture is of primary importance. In proportion as nations advance in population and other circumstances of maturity, this truth becomes more apparent, and renders the cultivation of the soil more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater propriety? . . . I have heretofore proposed to the consideration of Congress the expediency of establishing a national university and also a military academy. The desirableness of both these institutions has so constantly increased with every new view I have taken of the subject that I cannot omit the opportunity of once for all calling your attention to them." With marvelous foresight Washington urged the necessity for scientific research and education in America, and he planned at the same time for institutions to discover and collect knowledge, and societies to disseminate it. He saw also that agriculture was to be the chief industry in the country, and that it would need the assistance of science. Thus he appears to have associated plans for the advancement of agriculture with those for a national university. Congress promptly established the military academy, and some years later the naval academy and the department of agriculture. But it has not yet established the national university, which was the chief agency in Washington's mind for the development of all the sciences and arts of peace.

Agricultural Societies and Fairs.— The first society for the promotion of agriculture in the United States was organized at Philadelphia on 1 March 1785; and on the 4th of July following George Washington and Benjamin Franklin were elected members. A similar society was incorporated in South Carolina in the same year, which proposed, among other things, to establish an experimental farm — the first suggestion of the kind in our history. The New York society for the promotion of agriculture, arts, and manufactures, which had been organized on 26 Feb. 1791, published its first small volume of transactions in 1792. The Massachusetts So-

ciety for the Promotion of Agriculture was established 7 March 1792, and commenced, in 1797, the publication of bulletins. The Society for Promoting Agriculture in the State of Connecticut was organized in 1794, and published its first volume of proceedings in 1802. Washington was evidently familiar with the work of these agricultural societies; but his knowledge of such agencies was not limited to his own country. In Great Britain, the Bath and the West of England Agricultural societies had been established. Sir John Sinclair, the "inventor of statistics" and president of the Highland Society, had established, in 1791, the British Wool Society and the Sheep Fair at Newhalls Inn. After agitating the subject for a number of years, Sinclair secured the establishment of the Royal Board of Agriculture, and was appointed its first president in 1793. Washington's correspondence with Sir John Sinclair shows that he had the benefit of all the information to be obtained from the father of the British board of agriculture. Agricultural societies naturally led to the establishment of fairs and exhibitions. A member of the Massachusetts Society suggested first in 1801 that agricultural fairs should be held regularly at Cambridge spring and fall, and premiums be given for farm products. No action appears, however, to have been taken with regard to this suggestion. Dr. Thornton, the first commissioner of patents at Washington, suggested in 1804 that the sale of agricultural products and of cattle would be promoted by the holding of fairs on market days, as in England. As a result of this suggestion we learn from the 'National Intelligencer' of that year that fairs were held "in the mall on the south side of the Tiber." The first fair proved such a success that the citizens raised an appropriation of $50 for premiums for the next one, which was held in April 1805. The third fair, held in November 1805, appears to have been the last. Gov. Edward Winslow, of Massachusetts, is said to have brought to Plymouth, in the ship Charity, in 1694, "the first neat cattle that came into New England." It was appropriate that his descendant, Elkanah Watson, of Plymouth, should import the first pair of Spanish Merino sheep into Massachusetts, and should then give notice of an exhibition of them at Pittsfield. This small exhibit led to a larger enterprise and the establishment of stock shows in America. An invitation was published by Watson and some 20 other persons calling an exhibition of stock at the same place on 1 October. This cattle show was so successful that it became a permanent institution in Massachusetts. A number of public-spirited citizens of Maryland, Virginia, and the District of Columbia had in the meantime formed, in 1809, the Columbian Agricultural Society, which was for many years actively engaged in the work of educating the farmer through the agency of fairs. From these beginnings agricultural societies have spread all over our country, and agricultural fairs have become a potent agency for the dissemination of valuable information with regard to new crops, implements, stock, and improvement in agriculture generally. Nearly all of the States have now either boards of agriculture or commissioners or secretaries of agriculture in charge of the farming interests. Their work varies, but usually includes the collection of agricultural statistics, the preparation of weather and crop reports and the oversight of the stock interests, and frequently also the inspection and analysis of fertilizers and mixed cattle feeds, the testing and examination of dairy and other food products. Some of the State boards conduct the agricultural colleges, hold fairs, give premiums for fine stock, and hold farmers' institutes. The boards, commissioners, and societies all publish reports and bulletins and many of them accomplish a great deal of admirable educational work. The Patrons of Husbandry (Grange) and National Farmers' Alliance, organizations with many subordinate branches and local societies, have exerted great influence especially in educating the farmers and their families. The Farmers' National Congress meets once a year for the discussion of questions of general interest. For the stock interests, we have in this country a national live stock association, 5 national dairy unions, and 56 State dairy associations. There are 14 cattle breeders associations representing the interests of as many different important breeds, 18 horse breeders associations, 29 sheep breeders associations, 17 associations of swine breeders, etc. Nearly all of the States protect their stock from diseases through the agency of sanitary boards or veterinarians under the direction of the State boards or commissioners. There is a national league for good roads that is doing much to educate public opinion. Ten States have forestry commissions or provide for forest protection and improvement in some way. There are besides 18 forestry associations which are doing much educational work. Eleven national or interstate, and 54 State horticultural and kindred societies are at work. (For the names of these societies and the addresses of their officers, see the Year-book of the United States Department of Agriculture for 1898.)

Agricultural Schools.— The origin and development of agricultural schools in America was a part of a general educational movement against the old classical college and in favor of scientific and technical education. Perhaps the demand for agricultural education was the first one to be heard; but it had its origin in the same causes which gave rise to the demand for the application of science to all the arts and professions in life.

As the great universities of Europe grew out of monastic and cathedral schools, so our first American colleges were all the children of the churches. The preachers were in the early days almost the only learned men, and therefore the only teachers. In the case of the rural schools the preacher was both school director and teacher. The institutions for higher education were also founded and controlled by the associations and presbyteries of the different denominations, and the most learned of their clergy became the instructors. Naturally enough, as their founders and teachers were all preachers, these early colleges were devoted almost exclusively to the cultivation of theology, classics, and philosophy. Their parson-teachers taught what they held to be the only thing worth learning, and they were right in putting character and culture above everything else. Their methods produced a race of preachers, teachers, lawyers, statesmen, and soldiers scarcely equaled and never surpassed in any country. But a new and rapidly growing country like America needed engineers, chem-

ists, miners, and manufacturers, and an ambitious and intelligent people were not slow to make their wants heard. Some of the physical sciences, notably chemistry and geology, had already made great progress, and had revolutionized some of the arts. The popular writings of great scientific men, notably Liebig's 'Letters' on chemistry, were eagerly read, and people everywhere cherished bright hopes of the benefits to be derived from the application of science to the industries of life, and especially to agriculture. Discovery and invention were already doing much to develop the material resources of the world and to change the occupations of men. Steam was beginning to be used for the purpose of transportation, chemistry was being applied in working iron, in dyeing fabrics, and in many other arts. Great railroads were to be built, but with the exception of the military academy at West Point, there was no school to train the engineers to survey them. Mines of coal and iron were to be opened, but miners had to be imported to open them. Factories needed to be built, but engineers had to be brought over from England or Holland to build them. Iron works and many other important industries were calling loudly for chemists, who had to be obtained from Germany or France. These influences, but more especially the need of scientific knowledge in a rapidly developing country, produced a profound effect on the theories and practice of education; and thus a vigorous demand arose for the sciences and their applications to the arts of life. The old college was not meeting the new demands; but what the new college was to be, and what its methods, no one knew for a long time.

Columbia College, in the city of New York, appointed, in 1792, Samuel L. Mitchell "professor of natural history, chemistry, and agriculture." The records of the college do not show what instruction he gave in agricultural science, if any, but Prof. Mitchell, so far as we know, was, by title at least, the first professor of agriculture in America. The Philadelphia Society for the Promotion of Agriculture, of which Washington was an honorary member, appointed a committee on 21 Jan. 1794 to "prepare a plan for establishing the State Society for the Promotion of Agriculture, connecting with it the education of youth in the knowledge of that most important art." This committee made a report offering several alternative propositions for promoting agricultural education. One suggestion made was "the endowment of professorships to be annexed to the University of Pennsylvania and the College of Carlisle, and other seminaries of learning, for the purpose of teaching the chemical, philosophical, and elementary arts of the theory of agriculture." Another suggestion was to use the common school system of the State to educate the farmer in his business, "the county schoolmasters being made secretaries of the county societies, and the school-houses the places of meeting and the repositories of their transactions, models, etc. The legislature may enjoin on these schoolmasters the combination of the subject of agriculture with other parts of education." This is, so far as we know, the first formal effort made in the United States to present the claims of agricultural education to a legislature and to incorporate instruction in agriculture in the common schools.

United States Department of Agriculture.— The war with England, the expansion of territory, the rapid development of manufacturing, and many other causes, contributed to retard the progress of agricultural education for several decades after the beginning of the century. The agitation continued, but little was accomplished until after 1840.

Upon the motion of Elkanah Watson, the Berkshire Agricultural Society of Massachusetts presented in 1817 a memorial to Congress praying for "the establishment of a national board of agriculture in accordance with the original suggestion of President Washington." The bill reported in the House of Representatives was promptly defeated by a large vote. It was well known that President Madison was opposed to it on constitutional grounds. Others based their opposition on the indifference of the farmers of the country and the idea that such a board was not needed. The only striking event in the agricultural history of the country during the next decade was the agitation of silk culture, commonly called the "Morus multicaulis" craze from the variety of the mulberry tree which was introduced everywhere to supply food for the silk worm. Congress responded to the popular demand for information on this subject by ordering the preparation and publication of a manual of silk culture, which was done.

The United States Department of Agriculture grew finally out of the recommendation of President Washington for a national board of agriculture, but more immediately out of the seed distribution originated in the Department of State during the presidency of John Quincy Adams. The patent office was first in the hands of the Department of State, and the seeds collected by consuls in various parts of the world were turned over to it, as the scientific branch of the government for distribution. So it came about that when on 4 July 1836, the patent office was made a separate bureau and Henry L. Ellsworth, a practical farmer of Connecticut, was appointed commissioner, he found it one of his duties to distribute seeds and plants. It was a congenial duty and one for which he was well qualified both by education and experience. During his travels over the country as Indian commissioner, Mr. Ellsworth had been deeply impressed with the agricultural possibilities of the western prairies and also with the great ignorance and destitution of the settlers upon them. He believed that what they needed was better implements and seeds adapted to the climate and soils. So deeply impressed was he with the necessities of these people that, without the authority of Congress and outside of business hours, he collected seeds and plants, which he distributed to farmers in all sections of the country, but especially to those in the far West, using the postal franks of members of Congress for this purpose. This was the beginning of the seed distribution by the United States government, which has since grown to such colossal proportions. Thus also was born the United States Department of Agriculture. In his first annual report Mr. Ellsworth begged earnestly for an appropriation to continue and enlarge this distribution of seeds and one was made during the last days of the Twenty-fifth Congress which provided $1,000 from the patent office fund "for the purpose of collecting and distributing seeds, prosecuting agricultural in-

vestigations, and procuring agricultural statistics." With the exception of the years 1840, 1841, and 1846 Congress made a small appropriation for this purpose each year from the patent office fund. The first separate appropriation for agriculture, made in the year 1854, was $35,000, and it has never been less than that sum. An agent was authorized also at this time to "investigate and report upon the habits of insects, injurious and beneficial to vegetation," and a botanical garden was established. The same year arrangements were made with the Smithsonian Institution for collecting meteorological statistics. The present United States Department of Agriculture was established by an act of Congress, approved by President Lincoln on 15 May 1862. This act was chiefly due to the strong plea made by Commissioner of Patents David P. Holloway, of Indiana. It is remarkable that the other great act for the promotion of agriculture in America, known as the land-grant act establishing colleges of agriculture and mechanic arts, was passed by the same Congress and approved by President Lincoln on 2 July of the same year, both in the midst of the terrors of the Civil War. The act of 15 May 1862 did not establish an independent department of the government. Its chief officer was styled simply "commissioner of agriculture." He did not become a member of the Cabinet until 11 Feb. 1889, when President Cleveland approved another act of Congress making the Department of Agriculture an executive department.

Agricultural Colleges.— The demand for scientific and technical education did not cease as the years passed by, but grew louder and louder with the development of the country. The history of the agitation in New York may be taken as an illustration. In 1819 there was published anonymously at Albany a pamphlet on "the necessity of establishing an agricultural college," which has been commonly attributed to that active and intelligent man, Simeon De Witt, Surveyor-general of New York. He proposed the establishment of an institution to be called the agricultural college of the State of New York, to be endowed by the State and conducted under State authority. The 'Transactions' of the New York Agricultural Society for 1822 contain allusions to the same subjects, and the matter was never allowed to drop entirely out of sight. About 1825 a private agricultural college or school was undertaken in Columbia County. This was the period (1830 to 1850) of the agitation for the so-called "manual labor schools," and many of the schools of the time took that form. The Oneida Institute was one of the first of these schools, and it is said to have had a course of instruction in practical agriculture. These were not manual training schools or technical schools in the modern sense, but schools having farms attached where the students could support themselves by manual labor while pursuing their studies. This plan, which was received with much popular favor for a time and led to the establishment of numerous schools, was soon found to be impracticable and abandoned. The demand in New York for agricultural education grew steadily, and by 1838 petitions bearing 6,000 signatures were presented to the legislature demanding State aid in behalf of agricultural schools. The committee to whom the petitions were referred deplored in strong language "that there is no school, no seminary, no department of any school in which the science of agriculture is taught," and recommended very strongly the establishment of a school of agriculture. No action was taken at this time, but the matter came up in a different form at each succeeding session of the legislature, and appears to have grown steadily in favor. The State Agricultural Society helped greatly to advance the interests of the cause, and in 1844 appointed a committee of which Gov. Seward, Lieut.-Gov. Dickinson, and James S. Wadsworth, were members, to promote "the introduction of agricultural studies in the schools of the State," and also "for the purpose of selecting books for family and school libraries." It was resolved at the same time, "That this society regards the establishment of an agricultural institute and pattern farm in this State, where shall be taught thoroughly and alike the science, the practice, and the profits of good husbandry, as an object of great importance." This committee co-operated with the association of school superintendents, with the result that that body adopted, in June 1844, a resolution drawn by Prof. Potter, of Union College, setting forth the opinion that "the time has arrived when the elements and scientific principles of agriculture should be taught in all schools." Still the State took no action. However, numerous private agricultural schools were established.

Gov. Hamilton Fish first recommended, in January 1849, in his annual message to the legislature, the establishment of a State agricultural college. During the following session of the legislature Prof. Johnson, the great agricultural chemist of Scotland, was invited to Albany and delivered a course of lectures under the auspices of the New York Agricultural Society. The same year this society established a chemical laboratory at Albany for the analysis of manures, fertilizers, etc. Still nothing was done about the school. Prof. William H. Brewer writes: "In 1850 Mr. John Delafield, a graduate of Columbia College, where he may have received instruction from Prof. Mitchell, was living on one of the best farms of the State, in the town of Fayette, Seneca County. He was at one time president of the New York State Agricultural Society, and originated and carried out an agricultural survey of Seneca County. He took a deep interest in the cause of agricultural education, and owing to his action and energy on 15 April 1853, the State passed an act establishing an agricultural college. This act created a board of 10 trustees, of which Mr. Delafield was president, but appropriated no money. The college was to be located on Mr. Delafield's farm in the town of Fayette, but as he died 22 October of the same year nothing more was done about building a college there." The Rev. Amos Brown, principal of Ovid Academy, who was to become later the chief assistant of Senator Morrill in securing the passage of the land-grant act establishing agricultural colleges, appears to have gotten his inspiration and information from Mr. Delafield. He afterward became president of the People's College near Havana, N. Y., and after the passage of the Morrill Act in 1862 secured an act from the legislature of New York, giving the whole of its share of the land-grant to this college. But that institution failed to comply with the condi-

tions of the law, and the land-grant of the State of New York was turned over to Cornell University, which thus became the agricultural college of the State. This narrative has been introduced to show the growth of the idea which led to the establishment of Cornell University, probably our greatest agricultural institution. See CORNELL UNIVERSITY.

The first agricultural college to be actually established and put in operation was that of the State of Michigan. Article 13, section 11 of the constitution of the State of Michigan adopted in 1850, says: "The legislature shall encourage the promotion of intellectual, scientific, and agricultural improvement; and shall as soon as practicable, provide for the establishment of an agricultural school." This was the first State constitution to provide for the establishment of an agricultural school. It is noteworthy, also, that it was the first one to provide that all instruction in the district schools should be conducted in the English language. The act establishing the State Agricultural College of Michigan was passed on 12 Feb. 1855. The college was located upon a farm of some 500 acres, situated about four miles east of the city of Lansing; buildings were erected, and the college was formally opened in May 1847.

The legislature of Maryland incorporated the next agricultural college in 1856, which was, however, in part a private institution. Some 500 citizens of Maryland, and of the District of Columbia, together with a few from adjacent States, subscribed to a certain amount of stock, which the legislature required should be provided. The stockholders elected a board of trustees, and this body located the college upon the estate of Charles B. Calvert, situated in Prince George County, about nine miles east of the city of Washington. The institution was opened for students in September 1859, when Prof. Joseph Henry of the Smithsonian Institution, delivered the oration.

Marshall P. Wilder first urged the importance of establishing an agricultural college in Massachusetts, in an address before the Norfolk Agricultural Society made in 1849. The State Senate of Massachusetts passed a bill in 1850 establishing such a school, but it failed in the House. A committee was appointed to investigate the matter, and they sent Prof. Hitchcock to the continent of Europe to visit agricultural schools. His report was transmitted to the legislature by the governor in the following year, with the result that the Massachusetts Board of Agriculture was established in 1852. Mr. Wilder kept up the agitation, however, and finally in 1856 succeeded in obtaining from the legislature a charter of the Massachusetts School of Agriculture. The Massachusetts Agricultural College was not regularly opened, however, until 1867. The general assembly of the State of Pennsylvania incorporated the Farmers' High School, now the State College, in 1854. The act provided that people of different sections of the State might offer land and property and thereby secure its location in their midst. Funds for building and equipment were provided from the State treasury. The State Agricultural Society made certain donations, and the college was opened for students in the winter of 1859. These were the leading agricultural schools established before the passage of the Land-grant Act in 1862.

Closely related to these agricultural schools were the scientific schools established at Yale and Harvard between 1840 and 1850, in response to the same demand for a new education. John P. Norton was appointed professor of agricultural chemistry, vegetable and animal physiology at Yale College, New Haven, Conn., in 1846. Thus was begun the Sheffield Scientific School, which was more of an agricultural institution than any of the other schools of that time. Prof. Norton began his lectures in 1847, and for some years wrote voluminously for agricultural journals. He also prepared and published his first work, 'The Elements of Agriculture.' Among his first students in the course in agricultural chemistry was the distinguished Prof. W. H. Brewer, of the Sheffield Scientific School at Yale. The Lawrence Scientific School at Harvard, established about the same time, was founded upon an endowment of $40,000, given by the Lawrences, who, being interested in factories, caused this school to direct its attention more to the applications of chemistry to manfactures. Francis Wayland, president of Brown University, became greatly interested at this time in scientific and technical education, and took a prominent part in the discussion of the reforms needed to adapt the institutions of America to the requirements of the time. In his little book on the 'Present Collegiate System of the United States,' he argued earnestly in favor of the introduction of scientific subjects into the college curriculum and the adoption of a system of electives. A science hall and a museum of geology were erected at Brown in 1840; but means failed to support the scientific work, and Dr. Wayland was constrained to resign in 1855, when the old classical course was re-established. These changes were all parts of a general movement for the modification of the classical curriculum, and the introduction of scientific and technical study. Wherever this was done the sciences pertaining to agriculture were sure to be introduced. The next great movement in agricultural education began with the Land-grant Colleges. See COLLEGES, LAND-GRANT.

Requirements for Admission.— The requirements for admission to the agricultural colleges vary in the different States in accordance with the school systems and the other opportunities for preparation. The Western and Southern agricultural colleges usually take the students from what is known in this country as the eighth or ninth grade of the public school course. A majority of the institutions require for admission either certificates from the preparatory schools or examinations in the more important subjects. The average standard of admission to the agricultural colleges is presented in the report of the Committee on Entrance Requirements made to the association of colleges at the meeting in November 1896. They recommended the following (Rep. of Bureau of Education, 1896–7, p. 429):

"The committee holds that it is advisable, as a beginning, to determine the requirements in a few subjects upon which it is possible for all the colleges to agree, and to recommend others, which although too high at present for adoption by some of these institutions, may yet serve as a standard or goal toward which effort may be directed.

"As a standard series of entrance requirements, to be adopted as soon as possible, we recommend the following: (1) Physical geography; (2) United States history; (3) arithmetic, including the metric system; (4) algebra to quadratics; (5) English grammar and composition, together with English requirements of the New England Association; (6) plane geometry; (7) one foreign language; (8) one of the natural sciences; (9) ancient, general, or English history."

Many of the universities have a much higher standard of admission, some of them requiring a preparation fairly comparable with that for students entering the literary and scientific courses. Candidates for admission at Cornell, for example, must be at least 16 years of age and pass an examination in English, geography, physiology, and hygiene, history of the United States and England, Greece or Rome, plane geometry, elementary algebra, and at least two of the following subjects: Greek, Latin, French, German, and advanced mathematics.

Courses of Study.— The courses of study in the separate colleges for agriculture and mechanic arts are not essentially different from those of the agricultural departments of the State universities, with the exception that in most cases the work of the separate colleges begins a little earlier and is not so much differentiated as that in the universities. Many of the separate agricultural colleges have, however, quite as high requirements for admission as any of the State universities, and do as high a grade of work as the best of them. On the whole, it appears that practical agriculture occupies the highest place in the separate colleges, though more research in the sciences pertaining to agriculture is being carried on in the universities. In universities in which departments of agriculture are maintained, it may be said in general that the tendency is to make the four years' course in agriculture correspond in scope and thoroughness with those in philosophy, sciences, and engineering. As more means are obtained, instruction in agriculture is divided among an increasing number of specialists, who are provided with separate buildings, laboratories, and shops. It is characteristic of American State universities that they are seeing more clearly that agriculture and manufacturing are important human interests which may rightfully claim the best efforts of the greatest scientific intellects for their advancement, and that on the basis of agricultural sciences may be built a system of instruction in literature, mathematics, and technology which is as well or better adapted to produce scholars, investigators, and leaders in civilization as was the old philosophical or the pure science course. The courses of study in agriculture are variously arranged. Nearly all these institutions maintain a four years' course, which is made up usually of two years of preparatory sciences and general culture studies, followed by two years of more advanced scientific and technical agricultural work, largely elective. At present there is little demand in our country for the all-around agricultural expert, and few colleges attempt to educate them. Such an expert cannot be trained in four years, if at all. At present the agricultural colleges content themselves with giving their students a fair general knowledge of the sciences underlying agriculture, horticulture, and the animal industry, with opportunities to acquire experience in some one line of practical work. The arrangement of this four years' course differs a good deal in different institutions, but the standard for it is laid in the reports adopted by the association of American agricultural colleges at its meetings in 1896–7.

The course of study presents the largest problem now before the faculties of our colleges. The present courses and methods have been criticised for their lack of "pedagogical form," for the "confusion of studies," and especially for lack of "orderly sequence in the progress of instruction" which has made the classical education and to a certain degree the scientific and engineering courses of our institutes of technology processes commanding the respect of scholars the world over. These critics are in error when they speak of agriculture as an independent science, and propose to formulate the instruction in it as they would that in chemistry or in biology. The fact is, agriculture is not a science but an art, and what we are attempting to do in these colleges is to carry out the injunction of the Act of Congress of 1862 and "teach the sciences (chemistry, physics, geology, biology, vegetable physiology, etc., each including numerous branches), related thereto." For this reason the course of study in agriculture with good "pedagogical form" must be made up of a course in chemistry and agricultural chemistry, a course in vegetable physiology, a course in the physiology of animals, a course in soil physics, etc.— many distinct courses. When the student has mastered all these it would seem to be possible, if he stays at the college long enough, to teach him in good "pedagogical form," some of their applications in agriculture. As Prof. Jordan, director of the Maine agricultural experiment station, has well said: "The real and important need of which the farmer is conscious is for a knowledge of conditions and not for methods or for skill in manipulation. When he clearly understands the reasons for that which goes on about him, the right method will appear. The difficulties lie with explanations, not with mechanical processes. And besides, agriculture is not a business involving such delicate and intricate mechanical operations that attendance upon a college would be justified in order to learn them, although the modern dairy, the forcing house, and the fruit garden do require skill. The spraying of fruit with fungicides and insecticides illustrates how readily the necessary manipulation was acquired when the reasons for these operations became evident. It is the explanation of phenomena, then, which the extended course of study should give in order that the farmer may know how to adapt himself to the varying and complex conditions which he meets in his work."

This is the real problem and one which the colleges and universities are working out with marked success. Perhaps the colleges and universities having departments of agriculture are doing more immediate good to the largest number of persons through their short courses and their special schools for dairying, horticulture, etc., than through the long course. These short courses are designed to meet the wants of young farmers who desire practical, helpful instruction in agriculture after leaving the high schools and before taking up their chosen vocations.

A number of the colleges maintain courses in agriculture of 12 weeks beginning the first of January of each year. They usually include lectures on feeds and feeding, breeds of live stock, elementary agricultural chemistry, physics of soils, meteorology, elements of vegetable physiology, the chief facts of veterinary science, dairying, horticulture, and some of the leading facts of bacteriology. Courses are selected from these to meet the needs of special classes of students from different districts. Laboratory practice is usually given in soil physics, stock judging, dairying, vegetable physiology, and practical horticulture. Other short courses are limited to the chemistry and bacteriology of milk and practical dairying, or to plant propagation, grafting, pruning, and practical horticulture. These courses are more largely attended than the four years' course. The tendency at present seems to be to split up the four years' course into special courses or to distribute among the different short courses students who cannot attend the institution more than a few months at a time. It is encouraging to note that such students frequently return winter after winter for additional training.

Expenses of Students.— The expenses of students in the agricultural colleges of the United States vary with the location and advantages offered. The tuition is uniformly free to all students pursuing the agricultural courses. It is customary to charge small fees to cover the actual expenses of material used in the laboratories and shops. Students pay their own board and personal expenses. Some institutions give free lodgings, though a majority charge only the actual cost of the maintenance of the buildings, fuel, lights, etc. Many institutions have special funds with which to pay for student labor, which usually takes the form of a fixed allowance for work regularly performed. The total college expenses of a student will vary from $150 for a session of nine months at a Western or Southern college, located in the country, to $400 or $500 at a university in one of the Eastern States. More assistance and more opportunities for self-support are offered agricultural students than any others in our institutions. The tendency everywhere is to increase these opportunities and to reduce the expense of the students of agriculture, while all the facilities provided them are constantly improved.

Extension Work in Agriculture.— The farmers' institute is to the adult farmer what the agricultural school is to his son. They were the outgrowth in part of the public meetings of agricultural societies and State boards of agriculture, and in part of the extension work of colleges and universities. The object of these institutes is to bring the workers in the agricultural sciences and the practical agriculturists together for the discussion of questions of mutual interest. Through such discussion the farmer gets the benefit of the information which the scientist has obtained in the course of his investigations, and the scientist learns what the farmer's needs and difficulties are. The results of the practical tests made by the farmer of the scientist's theories are also brought out. By such conferences both classes of workers have their opinions and experiences broadened. Institutes in the United States are carried on under all conceivable auspices; most commonly, however, by the State commissioners, the State boards of agriculture, or the agricultural colleges. In some States there is an independent organization with a secretary of institutes in charge. Some States make special appropriations for institutes, others merely allow a limited amount of the funds appropriated for the board of agriculture or college to be used for this purpose. Subjects connected with good roads, public education, and the interests of the home and farm are also discussed frequently. Those connected with sectarian religion or partisan politics should be carefully excluded, but almost any other topic of interest to the local community may properly find its place on the programme of a farmers' institute. In States where institutes have beeen carefully planned and systematically conducted by competent persons they have become exceedingly popular, with the result that large appropriations are being made for them each year. Something like the farmers' institute is now held in almost all the States in the Union.

Closely related to the farmers' institute are the various other methods of agricultural college extension work, such as co-operative field experiments, correspondence courses in agricultural sciences, reading circles for farmers, and itinerant agricultural schools. Co-operative field experiments were inaugurated soon after the establishment of the colleges for agriculture. The college or station makes plans and supplies the fertilizers or gives prescriptions for the same, with full directions as to methods of carrying out the experiments. The farmers report upon blanks prepared for the purpose, and the different results are compared and published. A great deal of good has been accomplished in this way, especially in educating farmers as to the proper method of using chemical manures. Similar methods have been used in testing seeds of field and garden crops, and in testing insecticide and fungicide materials and methods. Such co-operative experiments have done much to promote the study of scientific agriculture in the States, and especially to develop habits of observation among the younger farmers, who are always the ones to take hold of this work.

Instruction by correspondence and by courses of home reading in agriculture have been well developed under the direction of the State College of Pennsylvania. The main features of the plan are, "first, a carefully prepared course of reading designed to cover the most important branches of agricultural science and practice; second, a reduction of the price upon the books needed; third, personal advice and assistance through correspondence; fourth, examinations upon the subjects read, with certificates and diplomas for those attaining a certain grade of excellence." "This course has attracted great attention at home and received numerous applications from farmer students, many of whom have done excellent work, completed the prescribed courses, and received certificates." The courses have now been extended to include five subjects, with five books in each one; namely, crop production, animal production, horticulture, dairying, and domestic economy. A supplemental list of 15 books is suggested from which students may select reading matter to form additional courses if they desire. The full course consists of the thorough study of 10 books, followed by an examination. Lessons are

provided from the various books, and sent the students free of cost, in the form of printed slips. They give suggestions for study, observation, and experiment, with references to the books recommended. Each lesson is accompanied by an examination paper covering the particular subject. The students are expected to file answers to all these questions and discuss them before they receive the second lesson.

The itinerant agricultural school, a still later scheme, has been best developed in the State of New York, under the so-called Nixon Bill, "for the purpose of horticultural experiments, investigation, instruction, and information in New York." This bill placed the sum of $35,000 under the control of the college of agriculture at Cornell University for the two years 1899-1900, and has enabled it to inaugurate a number of most interesting and promising experiments in promotion of agricultural knowledge, especially of nature study in the common schools. The itinerant agricultural school is one only of the plans now being tested by this institution. The meetings of these schools last two or more days.

Agriculture in the Common Schools.— From the earliest time it has been the idea of the friends of agricultural education that instruction in this subject should be given in the common schools. The subject has been presented to the legislatures of many of the States, and by some it has been required to be taught. Any real instruction in agriculture must be based upon a knowledge of chemistry, geology, and the physiology of plants and animals. Such a knowledge cannot be given to young children, and the old-fashioned school teacher, trained to study books, and not things, could give no instruction in nature or science. The whole system of education had to be revolutionized to prepare the way for the study of agriculture in the schools. Since the introduction of the natural method great progress has been made. Agricultural colleges have trained the professors, who, in normal schools have taught the teachers, who in turn have introduced the new methods in the common schools. The following extract relating to the Cornell attempt to introduce nature teaching into the rural schools is from 'Popular Education for the Farmer,' by A. C. True, Ph.D.

There is every reason to believe that the plan of "nature teaching," as proposed by Cornell University, may prove a grand success and be a very great benefit to farmers' children. The element of education which is at present most lacking in our common schools is the training of the powers of observation. The children need above all things else to be taught to observe carefully and correctly and to state their observations in clear terse language. The ordinary child, whether on the farm or in town, actually sees comparatively little in the world about him. The wonders of the trees and plants in park or meadow, of birds and insects flying about the house, float like shadowy visions before his eyes. "Seeing, he sees not." He needs a teacher who can open his eyes and fix his mind on the realities among which his daily life is passed. This accurate observation of natural objects and facts is the only foundation on which scientific attainments can rest. The scientist is chiefly a man who sees better than his fellow men. But it is also a great help in practical life. Many farmers acquire much of this power by their own unaided efforts. And these are the very men who most regret that they did not have in early life the help of a trained teacher. The farmer's child lives where he has the best opportunity for such training. It would benefit him in the practice of his art, and it would add an interest to his life which would do much to wean him from a desire to leave the farm for the turmoil and uncertain struggles of the town. With proper provision for the training of teachers in normal and other schools, it would be entirely feasible to have this nature teaching in all our common schools within a few years. It is such teaching that the child mind craves. With it the school becomes a delightful place and the teacher an angel of light.

Thus far only a few attempts have been made in this country to provide agricultural instruction of the high school grade. It is true that some of the agricultural colleges receive students directly from the common schools, but the constant tendency is to raise the grade of instruction in these institutions to a college basis and, under any conditions, they very imperfectly perform the duties of secondary schools of agriculture. The University of Minnesota has in recent years maintained a school of agriculture in which instruction in agriculture of a lower grade than that given in the college of agriculture has been successfully imparted. This school has proved quite popular. Some 300 students were in attendance last year, and it has been found desirable to offer courses for girls as well as boys. The State of Alabama has recently provided for the maintenance of a school of agriculture of secondary grade in each of the nine congressional districts of the State.

The establishment of such special schools of agriculture of high school grade is greatly to be commended. One of the best effects of such schools at the present time is to show the people what distinctions should be drawn between colleges and high schools for agricultural education. By the separation of these grades of instruction the colleges will be enabled to do their work more efficiently, and better opportunities will be secured for those students whose previous training only fits them for high-school work in agriculture. But it is not believed that these special agricultural high schools will fully meet the needs of our farmers for agricultural instruction of this grade. Any school so distant from the farmer's home as to necessitate long journeys and residence at the school for two or more years must necessarily be too expensive for most of the farmers' children, especially after they have reached an age when their services may be more or less utilized on the farm. What is needed is courses in agriculture in numerous schools to which farmers' children resort, near their homes, to "finish" their education after they are through with the common schools.

Research in the sciences related to agriculture was always prominent in the minds of the advocates of agricultural education. After the agricultural colleges were firmly established, and the work of instruction was well under way, it became evident that the department of research in these institutions needed a special endowment and to be placed under a somewhat separate management. The funds provided were not sufficient for the purposes of instruction, and research and experiment were in danger of being neglected at the colleges so thronged were they with the young people who came to secure the benefits of this free tuition.

Several of the land-grant colleges early attempted to establish separate departments for scientific research and practical experiments on the plan of the German experiment stations. The act establishing the agricultural college of Maryland, passed in 1856, contained a section requiring the college to establish a model farm and conduct "a series of experiments upon the cultivation of cereals and other plants adapted to the latitude and climate of the State of Maryland, and keep a careful record of the kind of soil upon which they were undertaken, the system of cultivation adopted, the state of the atmosphere, and all other particulars which may be necessary to a fair and complete understanding of the results of said experiments." This work was commenced in 1858 and continued two or three years only, when the Civil War stopped all the operations of the college. When Connecticut established her agricultural school in connection with the Sheffield Scientific School of Yale College, Samuel W. Johnson was appointed professor of agricultural chemistry, and experimental work was commenced. "To the influence of

the professors and pupils trained in this school, more than to any other single cause, is due the recognition of the importance of the establishment of agricultural experiment stations." In 1870 the trustees for the Massachusetts society for promoting agriculture granted to Harvard College a sum of money "for the support of a laboratory and for experiments in agricultural chemistry to be conducted upon the Bussey estate." A school of agriculture and horticulture had been founded upon the bequest of Benjamin Bussey. The work of the new institution commenced in 1871. The experiments consisted of field tests of fertilizers and chemical analysis of commercial manures. The first report was published in December 1871. Other interesting and valuable work was done the next few years, but the commercial crisis of 1873 crippled the institution financially, and it has since been able to make comparatively few original investigations.

At a meeting of the State Board of Agriculture of Connecticut on 17 Dec. 1873 Prof. S. W. Johnson of New Haven, and Prof. W. O. Atwater of Wesleyan University, urged the establishment of an agricultural experiment station "after the European pattern." The result of this movement was that the State of Connecticut made, in 1877, an appropriation of $5,000 "to promote agriculture by scientific investigation and experiment." This station was first connected with the chemical laboratory of Wesleyan University, at Middletown, which had been established by Orange Judd and was in charge of Prof. Atwater, but after two years it was reorganized under the direct control of the State and permanently located in the neighborhood of New Haven. The State of North Carolina established an agricultural experiment and fertilizer control station in connection with the State University at Chapel Hill, on 12 March 1877. The Cornell University experiment station was organized by the faculty of that institution in February 1879 without any special appropriation. The New Jersey station was organized in 1880. The Tennessee experiment station in 1882. From these beginnings the experiment stations multiplied in the States until 1887, when Congress passed the Experiment Station Act, known as the "Hatch Act," there were 17 stations already in existence.

The stations were also authorized to publish annual reports of their operations, and "bulletins or reports of progress" at least once in three months, which should be sent to "each newspaper in the State, and such individuals actively engaged in farming as may request the same." The franking privilege was given for station publications. In the annual appropriation bill for the Department of Agriculture for the fiscal year ending 30 June 1889, Congress established the office of experiment stations as a branch of the Department of Agriculture. It compiles and publishes the results of their work, and aids them in many ways.

The work of the American Agricultural Experiment Station supplements that of the colleges in many most important ways. It is fully described in the admirable publications issued by the office of experiment stations of the United States Department of Agriculture, to which the reader is referred for fuller information. See AGRICULTURAL EXPERIMENT STATION.

Consult: 'Reports and Year Book of the United States Department of Agriculture.'

CHARLES W. DABNEY,
President of the University of Cincinnati, Cincinnati, Ohio.

Agricultural Experiment Station. An institution for scientific research in agriculture. The modern agricultural experiment station owes its origin chiefly to the work of Boussingault and Liebig, born respectively in 1802 and 1803, although the earlier work of Sir Humphrey Davy, De Saussure and others had prepared the way for that of these great chemists. During the third decade of the century Boussingault established and for a few years maintained a chemical laboratory on his farm, and there began the combination of field experiment with laboratory investigation which characterizes the experiment station of to-day.

In 1837 a young Englishman, John Bennett Lawes (q.v.), began making experiments in the use of bone superphosphate on his ancestral estate at Rothamsted, near St. Albans, Hertfordshire, about 25 miles northeast from London. The success of these experiments led him to engage in the manufacture of superphosphate and also stimulated a desire for further investigation, and after some years of preliminary work, in 1843 he associated with himself Dr. Joseph Henry Gilbert, a young chemist and a recent pupil of Liebig, and the two entered upon a systematic line of research which has been continued without material change of original plan until the present day. For more than half a century these two men worked together; both received the well earned honor of knighthood, and before his death, which occurred in 1900, Sir John Lawes made provision for the permanent continuance of the work, under what is now known as the "Lawes Agricultural Trust."

The feature of the work of Lawes and Gilbert which distinguished it from anything that had previously been undertaken, except the work of Boussingault, was the combination of systematic and long continued field and feeding experiments with parallel investigations conducted in the chemical laboratory, in which the principal agricultural plants adapted to the English climate are grown both continuously on the same land and in various rotations, the composition of the crops and of the soils upon which they are grown being determined from time to time, and in which large numbers of animals have been fed over long periods and under such conditions that it was possible to determine the chemical elements consumed in the food and the proportion of each utilized by the animal. Extensive detours have also been made into other fields of chemical research, especially that of the assimilation of nitrogen by plants. For many years several general assistants have been employed, including chemists, botanists, computers and other help. The entire expense of this work has been met by the originator, except that a chemical laboratory was presented to him some years ago in recognition of the value of his work.

In 1851 a small company of Saxon farmers, organized as the Agricultural Society of Leipsic, incited by the revelations of Liebig and Boussingault (q.v.), who were then in the full zenith of their work, employed a young

chemist, Emil von Wolff, and started him in the experimental study of agricultural problems, especially those related to the feeding of animals. In a few years the government was induced to assume the cost of this work, and thus was established at Moeckern, near Leipsic, the first public agricultural experiment station in the world.

In the United States attempts at experimental research in agriculture were undertaken at the Agricultural High School, afterwards State College, of Pennsylvania; at the Michigan Agricultural College, and at the Maryland Agricultural College, all established between 1854 and 1858, and later several of the institutions organized under the National Agricultural College act of 2 July 1862, undertook some investigations of this character.

The first regularly organized agricultural experiment station in America was established at Wesleyan University, Middletown, Conn., in 1875, under the directorship of Dr. W. O. Atwater, a young chemist who had become enthused with the idea while studying in Germany. For the inauguration of this work private initiative was necessary; Mr. Orange Judd, then editor and proprietor of the 'American Agriculturist,' contributed $1,000 on condition that the State should appropriate $2,800 for the support of the station for two years. This offer was accepted and work was begun in October of that year. In 1877 at the expiration of this period the State assumed the entire support of the station, and it wa. removed to New Haven.

Similar stations were established by North Carolina in 1877; by New Jersey in 1880; by New York and Ohio in 1882; and by Massachusetts in 1883. During this period also several of the agricultural colleges organized their research work on a more definite basis, and by 1887 there were 17 stations in operation in 14 States.

In 1883 a bill was introduced in the House of Representatives of the National Congress by C. C. Carpenter, of Iowa, providing for the establishment of experiment stations in connection with the colleges of agriculture, but it was not voted upon. In the next Congress Mr. Cullen, of Illinois, introduced a bill providing for a grant of $15,000 annually to each State and Territory for this purpose. This bill was re-introduced in the following Congress by William H. Hatch, of Missouri, and after being so amended as to authorize States, in which experiment stations independent of the agricultural colleges had been previously established, to use the grant in support of such independent stations — a proviso applying to the five stations above mentioned — the bill became a law on 2 March 1887.

Under this law experiment stations have been established in every State and Territory in the United States, 50 such stations being enumerated in 1904 — the fund being divided between two stations each in Connecticut and New York; while additional stations have been established under State or territorial support in Alabama, Hawaii, Louisiana and Missouri, and in several of the States substations or test farms have been established under State support, but as adjuncts to the regular stations. In addition to these the National Government has established stations in Alaska, Hawaii and Porto Rico.

In 1904 the stations organized under the act of 1887, commonly known as the "Hatch Act," had a total income of $1,508,820.25, of which $719,999.67 was received from the National Government, the remainder, $788,820.58, coming from State appropriations, fees, sales of produce and other sources. The stations employed that year 795 persons in the work of administration and research, and published 393 annual reports and bulletins, which were sent to nearly 700,000 addresses.

The following are among the principal subjects under investigation by the American stations: (1) The soil: its physics, chemistry, and biology; including tillage, drainage, irrigation and the maintenance of fertility by crop rotation and the use of manures and fertilizers. (2) The plant: its physiology, chemistry, nutrition and pathology; the introduction of new varieties; improvement in productiveness by selection and breeding; the control of fungous and bacterial diseases and injurious insects; the various phases of forestry. (3) Animals: the special adaptations of the various breeds; the chemistry of animal foods and the economics of feeding; dairying and its manifold problems; the control of animal diseases.

In addition to the work above outlined, several States have laid upon the stations certain lines of police work, such as the inspection of fertilizers, seeds, drugs, foods and animal feeding stuffs for the prevention of adulteration; that of live stock to prevent communication of animal diseases, and that of orchards and nurseries for the control of insect pests and fungous diseases; but such work is not scientific research; it frequently interferes materially with the conduct of such research, and is more properly an executive function of the state government. In some States it is so recognized.

Under the provisions of the Hatch Act the stations are governed under the laws of their respective States, the National Government exercising no control except to make sure, through annual financial reports from the stations and through personal visits by officers of the Office of Experiment Stations of the Department of Agriculture, that the money appropriated by Congress is being expended for the purpose designated in the national law.

The stations, in connection with the colleges of agriculture, have organized an "Association of American Agricultural Colleges and Experiment Stations," which meets annually at some point in the United States for the discussion of matters pertaining to their work, and the Office of Experiment Stations publishes a monthly journal, the 'Experiment Station Record,' in which notices or summaries are given, not only of the publications of the American stations, but also of the scientific agricultural publications of the world.

While this work has been thus extending in the United States it has also spread over most of the civilized world, 728 such institutions being enumerated in other countries in a bulletin of the Office of Experiment Stations, published in 1904. The only countries in which experiment stations were not found in that year were Greece, China, Turkey, Russia, Afghanis-

tan, Beluchistan, Mexico, Central America, Bolivia, Colombia, Ecuador, Patagonia, Peru, Uruguay, and Venezuela.

The European stations as a rule are confined to single lines of investigation, and very often to inspection work merely, whereas the American station generally embraces several co-ordinate departments, each with a chief and one or more assistants and helpers, all working under the general supervision of a single director. Many of the European stations would be classed as substations in America. Another point of difference is that in Europe the stations are very generally limited to laboratory work, whereas in America, England and the English colonies the laboratories are generally used as adjuncts to field investigation.

The rapid extension of this work throughout the world and the large and constantly increasing sums of money devoted to it are sufficient evidence that it has obtained and holds the confidence of the people; but this position has been attained rather through the gradual substitution by the stations' investigations of demonstrated facts for the theories which had previously held sway in agriculture than by epoch-making discoveries, although a few of these also are to be placed to the credit of these institutions.

It was the Rothamsted Station which demonstrated that leguminous plants do not absorb and fix the free air nitrogen of the air through their foliage, a demonstration which cleared the way for the solution of a mystery which had puzzled the student of plant growth for many years, and Dr. S. M. Babcock, of the Wisconsin Station, perfected a method of determining the fat in milk, which has been adopted throughout the world, and for which a medal was voted to him by the legislature of his State; but it is the patient, plodding work, by which a body of exact knowledge in agriculture is being slowly accumulated, which has been the chief factor in winning confidence and support.

On 15 Feb. 1906 a bill, introduced by H. C. Adams of Wisconsin, passed the House of Representatives by a unanimous vote, increasing the national allotment to the experiment stations by $5,000 for each State for 1906, this amount to be increased by $2,000 annually until the total shall reach $15,000, at which amount it is to remain, thus making the total appropriations for this purpose from the general government $30,000 annually for each station.

Charles E. Thorne,
Director Agricultural Experiment Station, Wooster, Ohio.

Agricultural Machinery. See American Farm Implements.

Agriculture, in its strict signification, is the art of cultivating the earth for the purpose of causing it to produce more abundantly roots, plants, and seeds suitable for the sustenance or service of man, and for the support of the animals domesticated in his service. It was the first and has always been the most extensively practised of the arts.

In its accepted meaning, however, agriculture not only includes the tillage of the soil and the cultivation of crops, but also the rearing and feeding of all kinds of farm live stock, and in some instances the manufacture of the products of the farm into such forms as may be more convenient or more valuable for use or for sale. The manufacture of butter and that of cheese constitute recognized branches of the art of agriculture. The distinction between arable agriculture, which includes the cultivation of the ground and the growth of crops, and pastoral agriculture, which comprises merely the feeding and management of the flocks and herds of the farm, has been observed since the earliest times: "Abel was a keeper of sheep, but Cain was a tiller of the ground." In modern times, and probably in some degree at all times within the historical period, the practice of arable agriculture has been commonly associated in greater or less degree with the keeping and tending of live stock; but over immense tracts of the world's surface that are unfitted for arable cultivation the practice of pastoral agriculture still prevails, as the ancient days, wholly unmixed with the plodding labors of the husbandman.

All the great nations of antiquity which had attained to any degree of civilization, the Chinese, the Assyrians and Babylonians, the Phœnicians, and the Egyptians, appear to have held the art of husbandry in high esteem, and numerous references to agriculture and its practices are found scattered throughout all ancient literature.

The agricultural practices of Palestine are the subject of repeated allusions in the books of both the Old and New Testaments, and among the Greeks agriculture was described by such authors as Hesiod and Xenophon. The Romans attained very high perfection in agriculture, and the Latin literature devoted to this subject alone appears to have been extensive. Its authors include, among others, the names of Columella, who wrote a complete treatise on agriculture in 12 books, Vergil, whose 'Georgics' constitute the most famous of the classical poems on agriculture, as well as Varro, Pliny, and others.

It was in all probability during the Roman occupation that agriculture in Britain first attained the position of an art, but during the disturbed period of the Anglo-Saxon conquest its practice fell into inevitable neglect, and the Roman principles of culture were forgotten through disuse. When society became more settled, agriculture again revived, especially after the introduction of Christianity among the Anglo-Saxons. Under the feudal system introduced by the Normans, agriculture was long neglected in favor of war and the chase, crops were sacrificed to game, and laborers were starved that nobles might have sport. For several centuries agriculture made no progress, and its English literature did not commence till nearly 500 years after the battle of Senlac. This literature began with Sir Anthony Fitzherbert's 'Book of Husbandry,' published in 1525, which was followed half a century later by Tusser's metrical 'Five Hundred Points of Good Husbandry.'

About the middle of the 17th century the field cultivation of clover and of turnips was introduced into England by Sir Richard Weston and gradually extended. Blith's 'English Improver' was published in 1649, and the 'Legacy or Discourse on Husbandry,' by Hartlib, a follower of Cromwell, and a friend of Milton, in 1650. By the end of the century a number of other works on agriculture had been produced.

In the succeeding century still greater progress was made, of which the first steps were due to Jethro Tull, a gentleman of Berkshire, and to Lord Townshend. In Tull's 'Horse-Hoeing Husbandry,' published in 1731, was first advocated the system of sowing crops in drills or rows so wide that cultivation could be carried on between them. To Townshend belongs the credit of the introduction of the Norfolk or four-course rotation, which is still widely practised, and which has formed the basis of all the rotations of crops since adopted on light and medium land. The next great name is that of Robert Bakewell (1725-94), who discovered the method of improving live stock by judicious mating and selection. He formed the new Leicester sheep, which surpassed all pre-existing breeds in early maturity and fattening propensity, and thus exemplified the principles by which all breeds of farm live stock have since been improved. His methods were soon after applied with like success to the Southdown, the Cheviot, and other breeds. Bakewell's Leicesters were also extensively used to improve other sheep breeds by crossing. The same principles, applied in the end of the century to cattle by the brothers Colling, produced from the native Teeswater or Durham the Shorthorn, which has become celebrated as one of the valuable breeds. The improved Shorthorn has been even more extensively used in the improvement of other breeds of cattle than the Leicester in sheep. Herefords were subjected to similar selective treatment by Tomkins.

Other notable events of the 18th century were the rapid extension of the cultivation of the potato, which only attained a position of importance among field crops in England about the middle, and in Scotland in the latter half of the century. In this period were also founded the leading agricultural societies, which have exercised such a powerful influence in the education of farmers and the advancement of agriculture. These included the Highland and Agricultural Society of Scotland, founded in 1774; the Bath and West of England Agricultural Society, founded three years later; and the Smithfield Club, founded in 1793. In the same year there was established, chiefly through the exertions of the celebrated Sir John Sinclair, the first Board of Agriculture, which continued till 1816. Sir John Sinclair was its first president, and its first secretary was the famous Arthur Young, whose graphic descriptions of agricultural practices at home and abroad contributed in no slight degree to the general improvement of agriculture.

The history of American agriculture is a continuation of that of Europe so far as the methods and implements of the home-land were introduced by colonists in the New World, and with the exception of the raising of cotton and tobacco by the people of the Southern seaboard the early agriculture of the country was nothing more than the production of food for home or near-by consumption. Even so late as the beginning of the 18th century very little progress had been made, the old ways still holding their own. The development of agriculture in Great Britain and Europe, as outlined above, had its echo in America, but really substantial advance was not made until the wonderful achievements of the next century accomplished more for the world's benefit in decades than had been gained before in centuries. In considering the causes that produced this astonishing advancement and turned an industry into a science we will find in the last analysis that the prime agency was the improvement in the means and methods of transportation. The general adoption of power propulsion made it possible to market crops from lands that were otherwise outside the pale of cultivation, so the great fertile plains of the Mississippi and its tributaries, and the vast areas of Australia, Russia, and South America were added to the food-producing regions of the world. The possibility of marketing the products of these remote lands created a demand for machinery to make good the lack of laborers; then as the good soils became exhausted, or the pressure of demand necessitated additional supplies from cultivated land, the problems presented were solved by the labors of scientists, who brought chemistry to the aid of the tiller, and agriculture ceased to be a haphazard means of livelihood, becoming, even, almost independent of the vagaries of the seasons. The importance to the farmer of the application of power to the labors of the farm is shown by the statement of an official of the Department of Agriculture, who states that the amount of human labor necessary to produce a bushel of wheat was reduced in 66 years from three hours and three minutes to an average of about ten minutes, while the cost of that labor fell from 17¾ cents to 3½ cents a bushel.

The improvement in every line of human endeavor that comes through competition has not failed in agriculture, and it is no longer an acceptable reason for raising certain crops on a farm that they always have been raised there. The successful agriculturist looks upon his farm as a business plant, and strives in every possible way to get from that plant the maximum of product, fitting his crops to the peculiarities of the soil, or, if need be, fitting the soil to the requirements of the crops his market demands. Even the smallest farmer has the world for his market, for the apples raised on the hillsides of Vermont are sold in the markets of New Orleans, London, and Paris, and the small fruits and vegetables of the southern States are found in the far north at midwinter. The farmer has come to realize the value of such modern aids to business as the advertising pages of the newspapers, and it is no rare thing to find an up-country producer offering his products through the medium of the great metropolitan dailies. So agriculture has awakened with a start, and in great leaps and bounds placed herself in the front ranks of the century's progress.

The division of labor in agriculture has, as in other productive occupations, become a feature of the age. Although the farmer should still be somewhat of an «all-around man,» he no longer requires to be a plow-wright, farm-implement maker, harness-maker, woodman, etc., but may devote his entire attention to the more immediate demands of his vocation.

But farming itself has come very extensively under the influence of this division of labor, and each successful husbandman devotes his attention to a particular branch rather than attempt the cultivation of every farm product needed for home consumption. One is a wool-grower, another breeds horses or raises beef, or devotes

TWENTY-FOUR DOUBLE-ROW CULTIVATORS IN OPERATION.

his attention to dairying, or market gardening, or fruit growing, or some other specialty. Often a single crop, as tobacco, onions, potatoes, or wheat, receives his principal efforts.

Among a great variety of new and improved methods in tillage and soil improvements belonging to the century, tile drainage and sub-surface irrigation by means of pipes are instances of marked advance over old practices.

Ensilage for forage has been a long stride in the economical preparation and conservation of cattle food. By its means not only is it possible to furnish farm animals with a palatable and succulent food at all seasons, but an important saving of forage, and of labor in securing it, is effected. The introduction of silage as a cattle food marks the dawn of an intensive husbandry hitherto unknown, making it possible to increase greatly the number of animals kept on a given area, and correspondingly to increase the food supply for the human family.

The winter feeding of farm animals is no longer the task of a century ago, but has become a simple problem. Indeed, so easy has winter feeding become, that pasturage, the blessing of our fathers, has by comparison become difficult, and feeders are becoming keenly alive to the needs of a better system of summer feeding than pasturage alone affords.

Ever since the patriarch Jacob outwitted his father-in-law in the division of their flocks and herds by the use of « peeled rods,» the art of breeding has been more or less faithfully pursued. If we may judge of the results, however, this century has witnessed more progress in many directions than the 3,000 years preceding.

Practically all the improved breeds of swine belong to the more recent period. Sheep have undergone a marked transition in fleshing properties, and certain breeds have made no less conspicuous gains in the quality of their fleece. A sheep producing 52 pounds of wool in 13 months was unheard of a generation ago.

The beef breeds of cattle would hardly recognize their ancestors of a century ago as of the same race, while dairy cows of that time would forget their cud in contemplation of a Pieterje II., with a record of over 30,000 pounds of milk in a single year.

As instances of remarkable development in horses within the century may be mentioned the American trotter and the Kentucky gaited saddler. In the former instance the unnatural trot and pace, by selection, breeding, development, and training, have acquired the speed of a mile in 2 minutes 2¼ seconds and 1 minute 59¼ seconds, respectively, with a long list of performers of miles faster than 2:10. The perfection of a breed of horses taking each of five different gaits at a word from their riders, which every Kentucky gaited saddler must do, is another monument to the agricultural skill of the age.

In the diversity of talents used by husbandmen, those of the chemist play an important role. Evidence of this is found in the Wolff-Lehmann and other feeding standards. By patient study extending over a long period of time and a large number of animals, tables have been arranged showing the food requirements of all common domestic animals in all ordinary conditions of use. The chemical composition of feeding stuffs has been accurately determined. The percentages of nutrients — albuminoids, fat, and carbohydrates (starch, sugar, fibre, etc.) — digested by animals have been worked out and recorded. Numerous tests have been made to determine the most advantageous amounts and proportions of these nutrients for each of the various purposes for which animals are kept.

These results, compiled, arranged, and published, give the feeder information of inestimable value in the profitable pursuit of his vocation. These studies and investigations have not only proved of great advantage in feeding animals, but have resulted at the same time in the discovery of principles of human nutrition having an important bearing on man's subsistence.

Great strides have been made in methods of preventing and overcoming animal diseases, deserving of far more extended mention than it is possible here to make. The discoveries of Dr. Koch, resulting in the preparation of tuberculin as a diagnostic for consumption in cattle; the inoculation of cattle, rendering them immune from Texas fever heretofore considered fatal to all improved breeds; the successful potassium iodide treatment for milk fever; and a host of other discoveries,— have marked the century in veterinary achievements.

The occupation of the drover has passed away with the advent of railroad transportation of farm animals. While this belongs to the subject of commerce, it is of incalculable importance to agriculture as well. A very large share of the developments of husbandry may be ascribed to the opening up of the country by the grand facilities for transportation that now annihilate both time and space. Interstate and transoceanic traffic in live stock have recently been greatly improved by mechanical and scientific efforts until our cattle travel with a degree of safety and comfort not experienced by our human ancestors of a century gone.

It is said that among the early town records of Hadley, Mass., is an entry to the effect that the cows gave so little milk through the winter that the babies had to take cider as a substitute. Could the mothers of those babies go to Hadley now and observe the methods whereby winter has become the principal dairy season in the region, would they not feel that their lives were lived too soon?

Contrast the tedious and laborious setting of milk in shallow crocks for two days, then removing the cream with a piece of perforated tin, allowing it to sour in the kitchen, acquiring the aroma of boiled dinners in transit, churning with a dash churn and kneading by hand, with the new process of converting fresh milk into « butter for breakfast in a minute and a half.»

Co-operative butter- and cheese-making has transferred this work from the kitchen of the busy housewife to the factory of the expert, to the great advantage of the product and satisfaction of the wearied housewife.

Perhaps the most interesting achievement of all is the discovery of organic ferments which ripen or sour cream in butter-making, and the study of the specific effects of each of more than a hundred different species of these organisms upon the quality of butter. A practical side of this study is found in the present practice of selecting pure cultures of bacteria for cream-ripening, thus avoiding those forms pro-

ducing bad flavors and other undesirable qualities.

In several large establishments milk is now being modified by changing the proportions of its constituents to make it closely resemble human milk, and for other specific purposes in the feeding of infants, and it has even been made without the intervention of the cow.

During the past 40 years agricultural colleges have sprung up in each of the United States, doing work calculated to make the 20th-century agriculture far superior to that of the past.

Hand in hand with this educational work, investigations have been extended into all the varied fields of husbandry. Insects are yielding up their life's history, revealing facts suggestive of methods of protecting our interests against their ravages. Microscopic organisms reveal a power in nature till now undreamed of, disclosing among their numbers our warm friends and our most deadly foes. It has become possible to measure in heat and motion the energy in every pound of food fed to our animals. The calorimeter faithfully measures every gram of gas exhaled from balance between the intake and outgo, and notes the expenditure of energy in every movement of body or limb. Even the eccentricities of the weather are not allowed to pass unnoted. Forecasts of storm advise the haymaker to be on his guard, and frosts are not allowed to spring upon the ungathered crop unannounced.

Under their specific names the reader will find statistics for each crop, and further information on the general subject may be found under the titles AGRICULTURAL CHEMISTRY; AGRICULTURAL EXPERIMENT STATIONS; DRAINAGE; IRRIGATION, etc.

BIBLIOGRAPHY.— From the beginning of the 19th century interest in agriculture has called forth a very large number of works, both general and special, and also a long list of periodicals, some of which are devoted to individual products of the farm.

The following list of mainly American and British writings has been selected as representatives of the general subject and its main branches. Important specific works are mentioned under the particular subjects of which they treat:

General.— Allen, ‹New American Farm Book›; Bailey, ‹Principles of Agriculture›; Brooks, ‹Agriculture›; Emerson and Flint, ‹Manual of Agriculture›; Fairchild, ‹Rural Wealth and Welfare›; King, ‹Physics of Agriculture›; Loudon, ‹Encyclopædia of Agriculture›; Mortimer, ‹The Whole Art of Husbandry›; Morton's ‹A Cyclopædia of Agriculture› and ‹Handbook of the Farm›; Periam, ‹The American Encyclopædia of Agriculture›; Roberts, ‹The Farmstead›; Tull, ‹Horse-Hoeing Husbandry›; Voorhees, ‹First Principles of Agriculture›; Wilcox and Smith, ‹Farmers' Cyclopædia of Agriculture›; Young, ‹Annals of Agriculture.›

‹A History of Agriculture and Prices in England from 1259 to 1793,› by James E. Thorold Rogers (8 vols., 1866–98), is a work of immense research and monumental significance, undertaking to recover aspects of the history of the people of England which contemporary records of prices give the means of knowing. It sheds light not merely on agriculture, but on politics, political economy, etc., even education, and revolutionizes some accepted views.

Crops.— Flint, ‹Grasses and Forage›; Shaw, ‹Forage Crops Other Than Grasses,› and ‹Soiling Crops and the Silo.› For bibliography on individual crops see specific titles.

Drainage and Irrigation.— King, ‹Irrigation and Drainage›; Miles, ‹Land Drainage›; Waring's ‹Drainage for Profit and Drainage for Health›; ‹Report of the Massachusetts Drainage Commission›; and ‹Sewerage and Drainage›; Wilcox, ‹Irrigation Farming.›

Flowers, Fruits, Vegetables, etc.— Bailey's ‹Evolution of Our Native Fruits›; ‹Principles of Fruit Growing›; and Principles of Vegetable Growing›; Bailey and Miller, ‹Cyclopedia of American Horticulture›; ‹Barry's Fruit Garden›; Cara, ‹Bush Fruits›; Fuller's ‹The Nut Culturist,› and ‹The Small Fruit Culturist›; Harcourt, ‹Florida Fruits and How to Raise Them›; Henderson's ‹Gardening for Profit,› and ‹Practical Floriculture›; Lodeman, ‹The Spraying of Plants›; Nicholls, ‹A Text-Book of Tropical Gardening›; Oemler, ‹Truck Farming in the South›; Thomas, ‹American Fruit Culturist›; Waugh's ‹Fruit Harvesting, Storing, Marketing, etc.,› and ‹Systematic Pomology›; Wickson, ‹California Fruits.›

Historical.—Daubeny, ‹Lectures on Roman Husbandry›; Flint, ‹One Hundred Years' Progress›; Hoskyns, ‹Short Inquiry into the History of Agriculture›; Prothen, ‹The Pioneers and Progress of English Farming›; Rawlinson, ‹Ancient Egypt›; Rogers, ‹History of Agriculture and Prices in England›; Stephens, ‹Book of the Farm.›

Live-Stock and Dairy.— Aikman, ‹Milk, Its Nature and Composition›; Craig, ‹Judging Live-Stock›; Curtis, ‹Horses, Cattle, Sheep, and Swine›; Decker, ‹Cheese-Making›; Felch, ‹Poultry Culture›; Henry, ‹Feeds and Feeding›; Jordan, ‹Feeding of Animals›; Miles, ‹Stock-Breeding›; Robinson, ‹Poultry Craft›; Shaw's ‹Animal Breeding,› and ‹Study of Breeds›; Stewart's ‹Feeding Animals,› and ‹Shepherd's Manual›; Wallace's ‹Farming Industries of Cape Colony›; ‹Farm Live-Stock of Great Britain›; ‹India in 1887›; and ‹The Rural Economy and Agriculture of Australia and West Zealand›; Wing, ‹Milk, Its Products›; Wright's ‹New Poultry Book,› and ‹Practical Poultry Keeper.›

Manures.— Aikman, ‹Manures and the Principles of Manuring›; Griffith, ‹Treatise on Manures›; Harlan, ‹Farming with Green Manures›; Harris, ‹Talks on Manures›; Sempers, ‹Manures: How to Make and How to Use Them.›

Soil.— King, ‹The Soil›; Roberts, ‹The Fertility of the Land.›

Periodicals.— ‹American Gardening,› New York; ‹Farm and Fireside,› Springfield, Ohio; ‹Farm and Home,› Springfield, Mass.; ‹Farmer's Advocate,› London, Ont.; ‹Farmers' Review,› Chicago; ‹Farm Journal,› Philadelphia; ‹Florists' Exchange,› New York; ‹Michigan Farmer,› Detroit; ‹Practical Farmer,› Philadelphia.

Agriculture, Department of, an executive department of the United States, whose head is a member of the Cabinet with the title sec-

Photographed by Tibbits.

A COMBINED STEAM HARVESTER AT WORK IN THE FIELD.

The greatest of all agricultural machines, which heads the grain, threshes it clean, and lays it in bags in piles on the ground

retary of agriculture. It was formed early in 1889 under President Cleveland, the first secretary being Norman J. Colman, of Missouri; he was succeeded in the same year, under President Harrison, by Jeremiah M. Rusk, of Wisconsin; in 1893 President Cleveland in his second term appointed J. Sterling Morton, of Nebraska; in 1897 President McKinley appointed James Wilson, of Iowa, who still holds it (1902). Its germ was a distribution of seeds to farmers by the Commissioner of Patents in 1836, enlarged by Congress in 1839 to include the prosecution of agricultural investigations and collection of agricultural statistics; in 1854 a special appropriation was made and an entomologist employed; in 1855 a chemist and botanist were added and a propagating garden begun. In 1862 the Agricultural Bureau was established separate from the Patent Office, and President Lincoln appointed Isaac Newton, of Pennsylvania, Commissioner of Agriculture; the last Commissioner was Mr. Colman, the first Secretary. The Department's quarters in Washington are in a large park near the Washington Monument. Its functions are expressed by statute as: «To acquire and diffuse among the people of the United States useful information on subjects connected with agriculture in the most general and comprehensive sense of that word, and to procure, propagate, and distribute among the people new and valuable seeds and plants»; but scientific and administrative duties have been heaped upon it till it has become not only an enormous workshop and museum of every class of scientific research relating to plant and animal life and that of agricultural animals, but an establishment of practical services in trade and commerce, quarantine, statistics, tree-planting, road-making, irrigation, insecticides, and almost everything that can affect the interests of those engaged in raising and marketing all articles that grow from the ground or living things that feed on them. Even the Weather Bureau was transferred to it, in 1891, from the War Department. Its publication department is immense, and includes a ‹Year-Book,› regular ‹Farmers' Bulletins,› and a monthly list of publications, all sent free to applicants or obtainable through members of Congress. The periodicals, ‹Experiment Station Record,› ‹Monthly Weather Review,› and ‹Crop Reporter,› also works of more special character, are given free to scientific institutions and collaborators of the department, libraries, colleges, and experiment stations, and sold by the Superintendent of Documents. Its cost is about $4,500,000 a year, of which about $700,000 goes to the agricultural experiment stations. The detailed statement below will give a full conspectus of its activities.

Organization, Subdivisions, and Functions of the Department, 1902.

Office of the Secretary.— Supervision of public business relating to the agricultural industry and management of department subdivisions; advisory supervision over government agricultural experiment stations; control of quarantine stations for imported cattle and of interstate cattle quarantine, including inspection of cattle ships; also carrying into effect the interstate game laws and those on importation of noxious animals, with authority to control that of other animals.

The Weather Bureau.— Records daily existing atmospheric conditions and formulates therefrom — for distribution — forecasts of probable weather during the succeeding 48 hours. It maintains a central office in Washington, and about 180 subordinate stations in the United States and West Indies. It also receives daily telegraphic reports of observations in Canada, Mexico, the Azores, and the western coast of Europe.

The Bureau of Animal Industry.— Investigates the nature and prevention of communicable diseases dangerous to live stock, and takes measures for their extirpation; inspects live stock and their food products in interstate and foreign commerce, also the transport vessels for exported and quarantine stations for imported animals; disseminates information on our dairy interests and their foreign markets; and reports on our animal industries and means of improving them.

The Bureau of Chemistry.— Studies the chemical problems of agriculture: soils, fertilizers, and irrigation waters; agricultural products and industries; insecticides and fungicides; foods of man and beast; raw materials, products, and processes of agricultural-chemical industries; chemical relations which modify the results of environment — as soil, latitude, altitude, and meteorological conditions — on agricultural products; inspects food products imported or for export; and examines quality of materials used in road construction. The chemical problems of other departments are turned over to it.

The Bureau of Plant Industry.— Studies plant life in relation to agriculture, including vegetable, pathological and physiological, botanical, pomological, grass and forage plant investigations and experiments; has charge of experimental gardens and grounds, the Arlington experimental farm, Congressional seed distribution, seed and plant introduction, and tea-culture experiments.

The Office of Experiment Stations.— Supervises the expenditures of those in the United States, manages those in Alaska, Hawaii, and Porto Rico, and prepares publications chiefly based on their results, including the monthly ‹Experiment Station Record›; conducts relations with American and foreign institutions for agricultural education and research; and supervises special investigations ordered by Congress, in co-operation with the agricultural colleges and experiment stations.

The Bureau of Forestry.— Prepares and executes plans for conservative lumbering of woodlands, public or private; investigates trees and methods for planting, and gives practical assistance to tree-planters; studies commercially valuable trees for their special uses in forestry, and the relations between forests and fire, grazing, lumbering, stream flow, and irrigation; maintains a photographic laboratory and collection and a library.

The Bureau of Soils.— Studies physical and chemical properties of soils, and materials and methods of artificial fertilization, with their influence on the original soils; classifies and maps soils in agricultural districts to show the distribution of soil types for adaptability to certain crops and their management; investigates alkali problems and their relations to irrigation and seepage waters; reclamation of abandoned lands; studies tobacco soils and methods of cultivation

and curing, introduction of improved varieties, and methods of exporting tobacco.

The Division of Statistics.— Collects and digests statistics of agricultural production; area annually sown to each of the leading crops, their condition on the first day of each month, the quantitative results at close of the crop year, and estimated farm value 1 December. Supplementarily it collects periodical information on minor crops of importance, meadows and pastures, and the principal foreign crops. The stock of corn, wheat, and oats on United States farms at certain regular fixed dates is estimated, with the proportion shipped out of the county where grown; the number and value, by species, of animals on United States farms at the beginning of each year, and the annual losses from disease and exposure; also the annual clip of wool and average weight of fleeces, by States and Territories. It computes the world's production of the chief crops, by countries, and prices of principal agricultural products in various United States markets.

The Division of Publications.— This is the publishing house of the Department. It has general charge and assignment of expenditures under the appropriation for printing and distributing agricultural documents, preparation and distribution of the ‹Year-Book,› ‹Farmers' Bulletins,› and other bulletins, reports, and circulars; supervises the Department's printing and binding in the Government Printing Office; prepares the drawings for illustrations; and prepares and distributes official information and advance notices to agricultural writers.

The Division of Entomology.— Studies the entire field of insect life in its relation to humanity; primarily, insects injurious directly to man, to agriculture and horticulture, and to stored products; the geographic distribution of such insects, and their relations to climate. It conducts field and laboratory experiments with different classes of remedies, and reports thereon. It also studies beneficial insects — both those which are the source of industries, like the honey-bee, the silkworm, and the fig-fertilizing insect and those indirectly beneficial by preying on injurious ones. It makes large collections of insects and of insecticidal machinery and chemicals.

The Division of Biological Survey.— Studies the geographic distribution of animals and plants, and maps the natural life zones of the country; also investigates the economic relations of birds and mammals, recommends measures for the preservation of beneficial and the destruction of injurious species, and carries into effect the Federal laws concerning the importation of wild birds and other wild animals, and the interstate game laws.

The Office of Public Road Inquiries.— Investigates the United States system of road management, and the best methods of road-making and maintenance; experiments on best methods of road-building, and analyzes chemical and physical qualities of road materials; co-operates with agricultural colleges, experiment stations, and local authorities, in building short sections of road as object lessons, etc.

The Section of Foreign Markets.— Has for object the extension of our agricultural export trade. It studies foreign conditions of demand and supply (using chiefly foreign official statistics of production), and imports and exports, supplemented by details obtained from consular reports, trade journals, and other sources. In cases of special importance a representative of the office is sent to obtain by personal investigation the information needed.

The Division of Accounts and Disbursements. — Audits and pays all accounts and adjusts claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements, schedules, and contracts for annual supplies, leases, agreements, letters of authority, and all letters to the Treasury Department and Department of Justice; issues requisitions for the purchase of supplies, and requests for transportation; prepares the annual estimates of appropriations; etc.

The Library.— The librarian purchases books and periodicals, supervises their arrangement and cataloguing, and has charge of the preparation of catalogues, indexes, bibliographies, and similar publications.

Agrigentum, ăg-rĭ-jĕn'tŭm, a town in Sicily, of which this was the Roman name, the Greek name having been Akragas and the modern Italian name being Girgenti. It is thought to have been founded by Dorian colonists about 582 B.C. Its situation on the southern shore of the island was peculiarly strong and imposing, standing as it did on a bare and precipitous rock about 1,000 feet above the level of the sea. During the Greek period Agragas rose to a position of great wealth and importance, and was adorned with splendid temples and public buildings. Among Sicilian towns it was second only to Syracuse. In 406 B.C. the city received a blow from which its dignity and power never recovered, in its capture by the Carthaginians. Under the Roman dominion we do not hear much of the town, which, however, seems to have been always prosperous, having mines as well as the most fertile territory. The town is celebrated in Greek history as the birthplace of the famous philosopher Empedocles, and the celebrated and almost legendary tyrant Phalaris was ruler there,— in what capacity is not clearly recorded. In the history of fine art Akragas was famous as the centre of a school of sculpture and refined architecture. We still have vestiges of this in the extraordinary group of temples, that dedicated to Hera Lacinia; that called "Temple of Concord," a remarkably well-preserved monument of the Doric style; that called "Temple of Hercules," much ruined; and, finally, the gigantic Temple of Zeus, a building wholly unique in Grecian art as having columns engaged in the walls of the cellar and a great interior evidently treated as a public hall, and differing in this way from all other Hellenic temples.

Ag'rimony (*Agrimonia*), a genus of plants belonging to the natural order *Rosaceæ*, distinguished from the other genera of the same tribe (*Roseæ*) by having but two carpels enclosed in the deep tube of the calyx, from 7 to 20 stamens, and small notched petals. *A. eupatoria*, or common agrimony, is an erect, hairy, herbaceous plant found on the borders of fields and woods, by the wayside, etc., probably escaped from gardens, as it is not a native of the United States.

Agrippa, Herod. See HEROD AGRIPPA.

Ague. See MALARIA.

Aguilar, ā-gē-lar', **Grace,** an English writer: b. in Hackney, 2 June 1816; d. in Frankfort, 16 Sept. 1847. Of Jewish parentage, she at first devoted herself to Jewish subjects, but her fame rests on her novels, ‹Home Influence,› ‹A Mother's Recompense,› ‹Home Scenes,› and ‹Heart Studies,› etc., most of which were published posthumously under the editorship of her mother.

Aguilar de la Frontera, fron-tā'rä, Spain, a town of Cordova province, Andalusia; 26 m. S. by E. from Cordova. It has three good squares and several handsome public buildings, and in the time of the Moors was defended by a strong castle. The inhabitants are employed in agriculture, stock-raising, manufacturing, and in quarrying lime, gypsum, and freestone. Pop. about 14,000.

Aguil'arite, a native sulpho-selenide of silver, having the formula $Ag_2S.Ag_2Se$. It is found at Guanajuato, Mex.

Aguilas, ä-gē'läs, Spain, a flourishing seaport in Murcia province, about 37 m. to the S.W. of Cartagena, with copper and lead smelting works. It carries on considerable trade in ores, etc. Pop. 15,000.

Aguilera, Ventura Ruiz, ä-gē-lā'rä, ventoo'rä roo'ēth, lyric poet, «the Spanish Beranger»: b. Salamanca, 2 Nov. 1829; d. Madrid, 1 July 1881. After a medical course at home he became a Madrid journalist (1843) and an important official under Liberal governments; later a director of the Madrid Archæological Museum. His bold incisive editorials endeavored to instil fervid national patriotism into the masses, an aim also of his poems like «National Echoes» and «Satires.» His «Elegies» (1862) were masterpieces translated into nearly all European languages. He wrote also ‹The Book of the Fatherland› (1869); ‹A Christmas Legend› (1872); ‹The Modern Arcadia›; collections of novelettes, etc. Complete Works, Madrid, 1873.

Aguinaldo, ä'gē-näl-do, **Emilio,** the leader of the insurgents in the Philippine insurrection of 1896, and their chief in the Spanish-American war of 1898: b. in Imus, 1870. A Chinese mestizo, of Chinese and Tagalog parentage. His father was a planter and he received his early education at the College of St. Jean de Lateran and the University of St. Tomas in Manila. Later he became the protégé of a Jesuit priest, and was for a time a student in the medical department of the Pontifical University of Manila. In 1888 he had some trouble with the authorities and went to Hong-kong. Young Aguinaldo there became interested in military affairs and gained a knowledge of warfare. He learned something of the English, French, and Chinese languages, together with various native tongues. He achieved a reputation for intelligence, ability, shrewdness, and diplomacy, and had a personal magnetism which gave him influence among his countrymen. On the outbreak of the rebellion against Spanish authority in 1896 Aguinaldo became a commanding figure with the insurgents. He was at the head of the diplomatic party, which succeeded in making terms with the Spanish government, the latter paying a large sum to the Philippine leaders to lay down their arms. Aguinaldo quarreled with his associates in Hongkong over the division of this money, and went to Singapore, where he came in contact with the United States consul shortly before the breaking out of the war between the United States and Spain. On the representations of the consul Commodore Dewey telegraphed to have Aguinaldo sent to him. The insurgent leader arrived at Cavité shortly after the battle of Manila Bay. Aguinaldo was given opportunity to organize the Filipinos against the Spanish authority; but no promises were made to him and the insurgents were never officially recognized by the Americans. Friction early arose and the Americans protested against the cruel treatment of Spanish prisoners by the Filipinos. The strain became serious at the capture of Manila, the insurgents claiming the right to sack the city, which the Americans denied. On 12 June 1898 Aguinaldo organized a so-called Filipino Republic, with himself as president, but very soon proclaimed himself dictator. He protested against the Spanish-American treaty of peace, which ceded the Philippine Islands to the United States, and claimed the independence of the islands. He organized an extensive conspiracy among the native population of Manila, and ordered the complete massacre of the Americans, together with the entire European population of the city, while yet at peace with them. The plot was discovered in time and failed. The intention of Aguinaldo to oppose by force the American occupation had been growing increasingly evident, and on the evening of 4 Feb. 1899 his forces attacked the American lines in the suburbs of Manila. The news of this overt action caused the prompt ratification of the Spanish-American treaty by the United States Senate. Aguinaldo made a determined resistance to the Americans, and the rainy season soon prevented the latter from following up their uniform successes in the open field; but early in 1900 the organized insurrection, which was chiefly confined to the Tagalog nationality, was broken up, Aguinaldo driven into hiding, and his correspondence, order books, etc., were captured by Gen. Funston, who captured Aguinaldo himself at Palawan, Luzon, 23 March 1901. On 2 April he took the oath of allegiance to the United States. In January 1903 he sent a petition to Congress on the terrible conditions of famine and pestilence in the island.

Agulhas, ä-gool'yäs, **Cape,** the most S. point of Africa, lies about 100 m. E.S.E of the Cape of Good Hope, in lat. 34° 49' S.; lon. 20° 0' 40" E. The point is very dangerous for ships; fogs are frequent, the currents are uncertain, and there are many rocks to seaward. In 1849 a lighthouse was erected on the point. The Agulhas bank extends along the whole southern coast of Africa, from near Natal to Saldanha Bay. It has an average breadth of 40 miles, but is difficult of navigation. The waters abound in fish. Agulhas (Portuguese) means needles.

Agustite, a name given by Trommsdorf to a variety of apatite occurring in Saxony, and supposed by him to contain a new earth, named in German *augusterde*.

Aguti, á-goo'ti (Fr. through Sp. from the native name), a gregarious South American and West Indian rodent,— any species of the genus *Dasyproctidæ*. Agutis are destructive to crops, particularly to sugar-cane; they are forest-dwellers, living in holes, but they come out into the fields, usually at night, to feed. In some regions they are considered edible; in Brazil a species, the «pampas hare,» is hunted as game, and the others are hunted with a view to saving the crops. About the size of a rabbit, they more resemble squirrels, for their legs are long and thin, their ears short and round, their claws hoof-like, and tail stumpy. The tail and the hinder part of the body are covered with the long stiff hairs from which the genus is named. The spelling of the name is varied to acouchi, acouchy, agouti, agouty, and aguchi; in Guiana and the West Indies a species is called «achouchy» or «achuchi.» The same name has been applied to a species of cavy (q.v.).

Ahab, king of Israel 875–853 (?) B.C., son and successor of Omri (1 Kings xvi.–xxii.). He found his kingdom in extreme peril: whole districts in the north had been swallowed up by the growing Syrian kingdom with capital at Damascus, which menaced its very life; and Moab and Edom were possessions only to be held down by force, with Syria constantly inciting them to revolt. He proved a prince of great energy and ability: twice he drove back Ben-hadad of Damascus, and he held down Moab with a strong hand, crushing a wholesale insurrection, as proved by the inscription on the Moabite Stone (q.v.); he made the kingdom of Judah an ally and perhaps a vassal, and gained at least the neutrality and perhaps some of the resources of the kingdom of Tyre by marrying the Princess Jezebel. Unfortunately this involved letting her establish the worship of the Tyrian Baal, called Melkart, and made the extremists of the Yahwé priesthood his irreconcilable enemies and defamers. Yet he was no deserter of Yahwé, but merely a cool politician, who felt that his first duty to his country and even to its national religion was to save it from absorption in Syria, which would end Israel and the Yahwé cult at once; and 400 priests of Yahwé prophesied before him previous to his last campaign. His entire internal policy has been blackened by the affair of Naboth's vineyard, and Jezebel is a name of execration. Certainly the judicial murder was a great crime, but it shows at least that even an Oriental monarch 2,750 years ago could not expropriate an obstinate holder by sheer violence; defiance of royal orders was not as safe to let go for a precedent then as now; and more than one king has had his hand forced by his queen. Nor in fact did these things prejudice the larger interests of his reign. In 854 we find him strangely allied with his old enemy Ben-hadad against Shalmaneser (q.v.) of Assyria, though one would suppose he would gladly have seen Ben-hadad crushed, and Assyria was no immediate danger: possibly he was menaced from other quarters and dared not refuse. At any rate, Shalmaneser inflicted a crushing defeat on the allies at Karkar near the Orontes in 854, and Ahab recovered liberty of action if he had lost it: for the next year he engaged in a new campaign against Ben-hadad, in alliance with Jehoshaphat, king of Judah, and was killed in battle. The Biblical narrative is taken from two opposed sources: one embodying the popular tradition of Ahab as a brave, capable, and popular king, the other the priestly view of him as a bad man and monarch. His contest with Elijah (1 Kings xvii.–xix.) is a picturesque rendering of the latter.

Ahasue'rus, Scripture history, a king of Persia, the husband of Esther, to whom the Scriptures ascribe a singular deliverance of the Jews from extirpation, which they commemorate to this day by an annual feast, that of Purim, preceded by what is called the fast of Esther. Different opinions have been entertained as to which of the kings of Persia mentioned in other historical books may be the Ahasuerus of the Bible. He is probably the same as Xerxes. Ahasuerus is also a Scripture name for Cambyses, the son of Cyrus (Ezra iv. 6), and for Astyages, king of the Medes (Dan. ix. 1). The word Ahasuerus is merely the Latin form of the Hebrew Ashashverosh, and is believed by some to be a transcription of the Persian Khshayarsha ("venerable king"), and this name may be reasonably supposed to have been originally an appellative, so that its application by foreigners, like the Jews, to different royal personages is explained.

Ahaz, the 12th king of Judah, succeeded his father Jotham, 742 B.C. Forsaking his father's religion, he gave himself up so completely to idolatry that he is said to have caused his own son to pass through the fire to Moloch, and plundered the temple to obtain presents for Tiglath-pileser, king of Assyria, whose assistance he desired to obtain. His powerful ally freed him from his most formidable foes by invading Syria, taking Damascus, killing Rezin, the king, transporting the inhabitants to Kir, thus putting an end to the Syrian kingdom of Damascus, and by stripping Israel of the whole country east of the Jordan.

Aiken, S. C., city and county-seat of Aiken co., on the Southern Railroad, 17 m. N.E. of Augusta, Ga., and 120 m. N.W. of Charleston. It is one of the most picturesque and attractive towns in the United States, being located at an elevation of 600 feet above the sea, in the midst of numerous pine forests. The dryness of the atmosphere and the comparative mildness of the climate have combined to make Aiken the most noted health resort in the South. The town is the centre of a large and important agricultural district. There is located here the Aiken Institute for white students; the Schofield Normal and Instructive School and Immanuel Training School for colored youth, and several private schools, and academies for both sexes. Many Northern families of wealth and culture have winter homes here. Aiken was first incorporated in 1835, and is governed by charter, secured in 1890 and revised in 1897, which provides for a mayor elected every two years, and a city council composed of the mayor and six aldermen. The town officials are elected annually at town meetings. The water supply and sewerage system are controlled by the town. There are two national banks here, numerous large hotels, a number of manufactories, and several newspapers. Pop. (1890) 2,362; (1900) 3,414.

Aikinite. See Needle Ore.

Ainsworth, Frederick Grayton, American soldier: b. Woodstock, Vt., 11 Sept. 1852. He was appointed first lieutenant and assistant surgeon, U. S. A., in 1874; major and surgeon 1891; colonel and chief of Record and Pension Office in 1892, where he introduced the index-record card system by which 50,000,000 cards made the military and medical record of any soldier at once accessible. In 1899 he was appointed brigadier-general, and made editor of the "Official War Records."

Ainsworth, William Harrison, an English novelist: b. 4 Feb. 1805; d. 3 Jan. 1882. He was the son of a Manchester solicitor. He wrote 'Rookwood' (1834); 'Jack Sheppard' (1839); and about 40 other novels, including 'Guy Fawkes,' 'Tower of London,' 'Windsor Castle,' 'Lancashire Witches,' 'Flitch of Bacon,' etc.

Ainus. See JAPAN.

Air, the gaseous substance that envelops the earth and forms its atmosphere. (See ATMOSPHERE.) It consists almost entirely of the gases oxygen and nitrogen, which are merely mixed and not chemically combined; but in addition it contains many other substances in small amounts, among which are water-vapor, carbon-dioxid, nitric acid, ammonia, ozone, argon, neon, and organic matter, as well as dust, germs, and other solid particles held in suspension. In certain localities other components may occur. Near the sea, for example, salt can always be detected in it, and over the land it contains sulphates in small amounts. The quantity of water-vapor present in air varies greatly with time and place, and in all analyses and statements of its composition the water-vapor is supposed to have been removed first. The quantity of carbon-dioxid is subject to considerable variation also. It is very constant in the open country, where it constitutes about 0.043 per cent (by weight) of the air; in cities the percentage is higher, rising to 0.07 and occasionally to 0.10. In crowded rooms, especially where artificial lights are burning, the quantity of carbon-dioxid present may be even greater than this. In country air the percentage of carbon-dioxid is subject to a diurnal change amounting to about one-eighth of its total amount, more being present at night than in the daytime. This is undoubtedly due to the fact that plants absorb the gas by day and exhale it during the night. The proportion of nitrogen and oxygen in air is subject to variation also, though within much narrower limits. In general, 100 volumes of air contain about 21 volumes of oxygen and 79 of nitrogen. Regnault analyzed air collected in different parts of the world, and found that the volume-percentage of oxygen in the air of Europe varied from 20.903 to 21.0 per cent. The average of 17 samples collected from over the arctic seas gave 20.91 per cent. Regnault was of the opinion that sea air contains slightly less oxygen than land air; but Lewy considered that no distinct difference could be proved except in the tropics, where sea air exhibited a slight diurnal variation. Argon constitutes about 1 per cent of air, and neon about 0.001 per cent. The nitric acid present in the air is so small in amount that it can be detected only in rainwater, by which it is dissolved and brought down. It is very likely formed partly by the direct combination of oxygen and nitrogen under the influence of electric discharges, and partly by the action of ozone upon ammonia. The quantity present is greatest in summer and least in winter. The ammonia of the air occurs partly as carbonate and partly as nitrate. Its amount is exceedingly variable, ranging from 0.1 to 135.0 parts (calculated as carbonate) in 1,000,000 parts of air, the average amount being perhaps 6. The amount present decreases during a heavy rain, but within a few hours it returns to the normal amount again. No ozone can be detected in city air, and air over marshes and in malarial regions contains very little of it. Normal country air contains not more than one volume of this gas to 700,000 of air. It is more abundant in summer than in winter, and is most noticeable during thunderstorms and heavy winds. In the laboratory ozone is produced by the action of electric discharges upon oxygen, and it is probably produced in the air in the same way. Hydrogen peroxid has been detected in the air, and some authorities consider that it may be present in greater abundance than ozone, and that it may sometimes be mistaken for ozone. (For further information on the composition of the air, see Angus Smith's 'Air and Rain.') According to Regnault, one cubic centimeter of air that has been freed from water-vapor, carbon-dioxid, and ammonia, weighs 0.0012932 gramme when the air is at the temperature 0° C., and under a barometric pressure of 760 millimeters of mercury at Paris (lat. 48° 50′ N.), and at a height of 60 metres above the sea. In English equivalents this means that at ordinary atmospheric pressure and at the temperature of melting ice (32° F.) a cubic foot of air weighs 0.080681 pound; «ordinary atmospheric pressure,» signifying the pressure that would be exerted by a weight of 14.7 pounds, resting upon a base one inch square at sea level in the latitude of Washington. When a mass of air, originally at atmospheric pressure and at the freezing-point (32° F.), is heated to the boiling-point (212° F.) without changing its volume, its pressure becomes 1.36728 atmospheres according to Balfour Stewart, or 1.36706 according to Wiebe and Böttcher. The average of these is 1.36717, which agrees well with the value 1.36719 as given independently by Morley and Miller. The older estimates of Regnault and Magnus are probably too small. The specific heat of air (the pressure being kept constant) is 0.2375 according to Regnault, and 0.2389 according to Wiedemann. The specific heat (the volume being kept constant) is 0.1715 according to Joly's direct measurement with the steam calorimeter. Air cannot be liquefied by any pressure whatever so long as its temperature is higher than about 220° F. below zero (−140° C.); but if it be first cooled to a temperature slightly below this it condenses to a liquid upon the application of a pressure of 39 atmospheres. (See CRITICAL POINT.) If it be cooled to a temperature materially lower than 220° F. below zero, it can be liquefied by a correspondingly smaller pressure. Liquid air is opalescent at first, probably from particles of solid carbon-dioxid held in suspension. These can be separated by filtration, or they will rise to the surface in a short time, leaving the clear, transparent air beneath. When liquid air is ex-

posed in a glass vessel it absorbs heat rapidly from surrounding objects, and boils actively until it has entirely evaporated. The nitrogen that it contains evaporates faster than the oxygen, however, and the liquid remaining in the vessel becomes increasingly rich in oxygen until toward the last it consists almost entirely of that gas. Liquid air may be frozen to a clear, transparent solid by surrounding it with liquid oxygen and then forcing the evaporation by means of an air-pump. Liquid air is of great interest to the physicist for many reasons; but its importance in the arts has been grossly exaggerated. In particular, the project that is put forth from time to time, to utilize liquid air for running a motor that shall condense more liquid air than it consumes, is impossible of realization, because although such an action would not necessarily imply perpetual motion it would violate the second law of thermodynamics. (See THERMODYNAMICS.) If liquid air is confined and allowed to become warm through the absorption of heat from its surroundings its expansion gradually generates an enormous pressure. This fact, together with the safety with which liquid air can be handled, has led to its use to a limited degree for blasting in tunnels and mines, where the presence of the irrespirable products of combustion of ordinary explosives is objectionable; but even this application has been discontinued, owing to certain grave and apparently insuperable practical difficulties that were encountered. See LIQUID AIR.

The scientific study of the air has been much stimulated in recent years by the establishment of the Hodgkins Fund. In October 1891 Mr. Thomas George Hodgkins of Setauket, N. Y., made a donation to the Smithsonian Institution, the income from a part of which was to be devoted to the «increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man.» The first prize of $10,000 from this fund was awarded on 6 Aug. 1895 to Lord Rayleigh of London, and Prof. William Ramsay of University College, London, for their discovery of the previously unknown element argon in the atmosphere. (See ARGON.) A prize of $1,000 was also awarded at the same time to Dr. Henry de Varigny of Paris, for his 'L'Air et la Vie' («Air and Life»), which was considered to be the best treatise upon atmospheric air, its properties, and relationships. Further information concerning the Hodgkins Fund may be had from the Smithsonian Institution, Washington, D. C. (For information concerning dust and germs, see Tyndall's 'Fragments of Science,' and Dr. T. Mitchell Prudden's 'Dust and Its Dangers.')

Dephlogisticated Air, in the old chemistry, was air that had been deprived of phlogiston (q.v.); in modern terminology it is called oxygen. Fixed air was Dr. Black's name for carbon-dioxid, suggested by the fact that certain alkaline substances can «fix» this gas, or combine with it to produce a solid substance.

The word «air» also occurs as an element in a host of compound words. The significance of many of these is evident, but some few call for special mention, and they will be found below in their respective order.

A. D. RISTEEN, PH.D.,
Editorial Staff, 'Encyclopedia Americana.'

Air, in music (in Italian, *aria*), means a continuous melody in which some lyric subject or passion is expressed. The lyric melody of a single voice, accompanied by instruments, is its proper form of composition. Many of the Italian airs of the present, together with too great a proportion of the popular music of the day, are destitute of meaning and character. The song-writers of Germany strive to construct their airs in direct conformity to the meaning of the words. Air is also the name often given to the upper or most prominent part in a concerted piece, and is thus equivalent to treble, soprano, etc. *Arietta* signifies a short, less elaborate air than *aria*, and is designed to express a more simple and transient emotion.

Air-bath, an apparatus designed for drying substances by exposing them to air of any desired temperature.

Air Beds and Cushions, often used by the sick and invalids, are composed of india-rubber, or of cloth made air-tight by a solution of india-rubber, and when required for use filled with air, which thus supplies the place of the usual stuffing materials. They tend to prevent bed-sores from continuous lying in one position. They are also cheap and easily transported, as the bed or cushion when not in use can be packed in small compass to be again inflated with air when wanted.

Air-bladder. See FISH.

Air-blast, a stream of air, issuing from a nozzle or other aperture under pressure. Such blasts are used for throwing sand or other abrasive material against a body that is to be eroded or polished; for forcing the fires of forges or furnaces, and for burning out the impurities in pig iron in the manufacture of Bessemer steel; for removing dust from grinding-machines and saws; for cleansing woven fabrics; and for multitudes of other purposes.

Air-box, a flue or other form of conduit conveying air to or from a furnace or into a mine for ventilation.

Air Brake, a mechanical apparatus, by which the expansive force of compressed air is employed to stop or control the speed of railroad trains. The air brake, in its present perfected and efficient form, not only represents the result of the remarkable progress of railroad operation during the last quarter of the 19th century, but has also contributed in no small degree to the character of the development of railroad practice. The air brake has developed into its present form through a series of stages, each of which was dictated by the occurrence of new conditions; and the modification of the air brake to meet such conditions has, in each case, enlarged the field of progress in railroad transportation. The original conception, and practically every succeeding improvement, of the air brake has been due to the quick perception and ingenuity of George Westinghouse, so that a review of the development of the Westinghouse air brake forms practically the history of the art. In the course of its development, the air brake has become known in four different forms — the straight air brake, the automatic air brake, the quick-action automatic air brake, and the high-speed air brake — each fulfilling the requirements of its day and forming the foundation of the structure of the next succeeding form.

The Straight Air Brake.— The straight air brake was the earliest and simplest form and was introduced by Mr. Westinghouse about the year 1869. An air compressor was attached to and operated by steam from the locomotive, and compressed atmospheric air into a storage reservoir, also located upon the locomotive. A line of ordinary gas or water pipe, commonly called the train pipe, extended from the reservoir through the engineer's cab and back underneath the tender and each of the cars of the train. Between the cars, the train pipe was connected, by means of rubber hose and suitable couplings, so as to form a continuous line throughout the length of the train. Near the centre of each car was placed an air cylinder, called the brake cylinder, which was connected by means of a short branch pipe with the train pipe. The brake cylinder contained a piston with a stem which was connected, through a system of levers and rods, with the brake shoes which were to be applied to the car wheels to check the motion of the train. In the cab, and within reach of the engineer, an operating valve, consisting of a three-way cock, was placed in the line of the train pipe. By means of this valve, the engineer could permit air to flow from the reservoir into the train pipe and connected brake cylinders, thereby forcing out the pistons and applying the brake shoes to the wheels. When sufficient air pressure to meet the requirements of the occasion had thus been admitted to the brake cylinders, the engineer could move the handle of his operating valve into such a position as to cut off further flow of air from the reservoir and to retain within the brake cylinders so much air pressure as had already been applied. By moving the handle of the operating valve into still another position, the engineer could cause the air already accumulated in the train pipe and brake cylinders to be discharged, through the operating valve, into the atmosphere, thereby releasing the pressure of the brake shoes upon the car wheels.

Control of the Air Pressure.— By means of this apparatus, the degree of air pressure in the brake cylinders, and, consequently, the pressure of the brake shoes upon the wheels, could be varied by the engineer from such a moderate application as would be required for checking the speed of the train upon descending grades or in bringing the train gently to a stop at stations, to the most powerful application required when an immediate stop of the train is demanded. This form of air brake came into quite extensive use upon the comparatively short passenger trains of that period. As the length of the trains became increased, however, it was found that a serious loss of time occurred in the operation of applying the brakes, because of the fact that all the compressed air for operating the brake cylinders of the different cars must travel back throughout the length of the train pipe from the storage reservoir to the brake cylinders, which operation was seriously retarded through the frictional resistance presented by the walls of the train pipe to the rapid passage of such a considerable quantity of compressed air. Also, in the case of the accidental detachment of a portion of the train while in motion, the brakes upon the detached cars were no longer capable of being applied by the engineer. Again, if the rubber coupling hose burst, or if any other portion of the apparatus became ruptured, the escape of the compressed air at such a point prevented the effective application of the brakes, and the control of the train was thereby lost.

The Automatic Air Brake.— The automatic air brake, introduced by Mr. Westinghouse in 1876, was designed to remedy the defects of the earlier system and to meet the advancing requirements of the time. The apparatus consisted of that already employed in the straight air-brake system, with the addition upon each vehicle of a storage reservoir, of sufficient capacity to supply the brake cylinder upon that vehicle, and a valve mechanism, called a triple valve, operated by variations in the air pressure in the train pipe, to control the operation of the brake cylinder. This triple valve was placed in the branch pipe leading from the train pipe to the brake cylinder, and was also supplied with a pipe leading to the new storage reservoir. It was called a triple valve because it performed the three functions of (1) permitting air to flow from the train pipe into the storage reservoir, for the purpose of charging the latter with air pressure; (2) causing the compressed air to flow from the reservoir into the brake cylinder, for the purpose of applying the brakes, and (3) permitting the compressed air to escape from the brake cylinder to the atmosphere, to remove the pressure from the brake cylinders and thereby release the brakes. The storage reservoir upon the locomotive became thereafter known as the main reservoir, and those upon the individual cars became known as auxiliary reservoirs. The characteristic feature of the automatic air brake is the triple valve, under the immediate control of which are all the operations of the brakes upon individual cars.

The triple valve, with the parts in their normal positions when the brakes are not applied, is illustrated, in section, in Fig. 1. The location of the several connections for the branch pipes to the train pipe, the auxiliary reservoir and the brake cylinder are indicated. A piston *a* is adapted to move backward and forward in a piston chamber, from which the piston stem *b* extends forward into a somewhat smaller valve chamber, containing a slide valve *c*, which is loosely confined between two shoulders upon the piston stem. Within the slide valve *c*, there is a small poppet valve *d*, called the graduating valve, which is secured by a pin to the piston stem *b*. When compressed air is admitted into the train pipe from the main reservoir by the

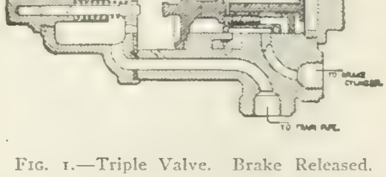


Fig. 1.—Triple Valve. Brake Released.

engineer, it enters the triple-valve structure through the passageways leading to the left of the piston *a*, where its pressure forces the piston and its accompanying parts into the positions shown in Fig. 1, if they were not already

in those positions. In this position of the piston, the small feed grooves *h* and *i* permit the compressed air to gradually pass from the train pipe, around the piston, into the valve chamber, and thence into the auxiliary reservoir, which thus becomes ultimately charged with the same pressure of air that exists in the train pipe. The brake apparatus is now in operating condition.

To apply the brakes, the engineer discharges a portion of the air contained in the train pipe, through his operating valve, whereby the air pressure in the train pipe and the chamber at the left of the piston *a* is more or less reduced. Owing to the inability of the compressed air in the auxiliary reservoir to pass rapidly out through the small feed grooves *i* and *h*, the superior pressure remaining in the auxiliary reservoir and valve chamber forces the piston *a* to the left, thereby first cutting off communication between the auxiliary reservoir and the train pipe through the feed groove *h*, and simultaneously withdrawing the graduating valve *d* from its seat in the slide valve. The shoulder at the end of the piston stem *b* then comes into contact with the end of the slide valve *c*, which subsequently accompanies the piston in its progress toward the left, until the latter is finally arrested by coming into contact with the stem *j*, which is supported in the position shown by a spring called the graduating spring. The positions of the parts are then as shown in Fig. 2.

Compressed air from the auxiliary reservoir now passes through a transverse port *e* in the slide valve, the passageway uncovered by the removal of the graduating valve *d* and the passageway *f* and connecting pipe to the brake cylinder, where it forces out the brake-cylinder piston and causes the brake shoes to be applied to the wheels. The discharge of air from the auxiliary reservoir into the brake cylinder necessarily results in reducing the air pressure in the auxiliary reservoir and valve chamber of the triple valve, and such discharge and reduction of air pressure continues until the pressure has become slightly below that of the air remaining in the train pipe and the connecting chamber at the left of the triple-valve piston. The slight preponderance of pressure then existing upon the left face of the piston *a* causes it to move to the right until the graduating valve *d* becomes seated in the slide valve and thereby prevents further discharge of air into the brake cylinder. The air pressure then existing in the brake cylinder causes the brake shoes to remain applied to the wheels, with a corresponding retarding effect upon the car.

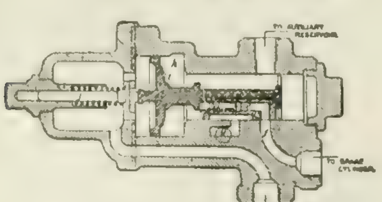


Fig. 2.—Triple Valve. Brake Applied.

Graduating the Pressure.— Should it appear to the engineer that an increased retarding force of the brakes is desirable, he discharges a further portion of the air remaining in the train pipe, through his operating valve. This results in a further reduction of the air pressure in the train pipe and the connecting chamber at the left of the piston *a*, whereupon the preponderating pressure in the auxiliary reservoir and chamber at the right of the piston causes it to again move to the left, until stopped by the stem *j*, thereby moving the graduating valve *d* and reopening the passage through the slide valve for the further discharge of air from the auxiliary reservoir into the brake cylinder. This discharge continues until the air pressure in the reservoir and chamber at the right of the piston *a* has become again reduced to a point slightly below the pressure yet remaining in the train pipe, when the preponderance of the latter upon the left face of the piston moves it inwardly and once more cuts off further discharge of air to the brake cylinder, by reseating the graduating valve *d*. This process, customarily called graduating, may be again repeated by the engineer, if the air pressure in the brake cylinder is still found by him to be insufficient to meet the demands of the occasion. In this manner, the engineer is enabled to apply the brakes with any of the various degrees of force required under the variable conditions calling for checking the speed of the train or for bringing it to a smooth and gentle stop at stations.

To discharge the air from the brake cylinder and release the brakes, the engineer moves the handle of his operating valve into the position for restoring communication between the main reservoir and the train pipe. The air pressure in the train pipe is thereby elevated, and, acting upon the left face of the triple-valve piston, moves it, with its connected valves, to the right, until it again reaches the position shown in Fig. 1. In this position of the slide valve, the passageway *f*, connected with the brake cylinder, is brought into communication, through a cavity in the lower face of the slide valve, with a port and passageway *g* leading directly to the atmosphere. The air in the brake cylinder thereby discharges to the atmosphere and the brakes become released. At the same time, the feed groove *h* again establishes communication between the train pipe and the auxiliary reservoir, so that compressed air from the main reservoir upon the locomotive passes into and recharges the auxiliary reservoir, so that it is restored to a condition of readiness for again applying the brakes.

An Emergency Discharge.— Should an emergency arise, in which it is important to stop the train quickly, the engineer discharges at once a considerable quantity of air from the train pipe, through his operating valve, thereby rapidly reducing the pressure upon the outer face of the triple-valve piston. This results in such a considerable preponderance of pressure upon the right face of the piston that the movement of the latter toward the left cannot be resisted by the spring supporting the stem *j*. The spring becomes compressed and permits the piston to continue its movement to the left until stopped by reaching the end of the chamber in which it operates. Under such conditions, the slide valve *c* moves so far to the left as to completely uncover the passageway *f* leading to the brake cylinder. A less obstructed discharge of air from the auxiliary reservoir to the brake cylinder results, and the maximum air pressure which can be supplied in the cylinder by the air in the auxiliary reservoir is more quickly attained.

As the automatic air brake is applied by an operation of the triple valve which results from the discharge of air from the train pipe to the atmosphere, it is evident that the application of the brakes need not be confined to the manipulation of the operating valve by the engineer, but will result from any cause by which the train-pipe air pressure may become sufficiently reduced. It was this feature of the apparatus which gave it the designation "automatic." Should any portion of the train become detached, or should the train pipe or hose become ruptured, a reduction of air pressure in the train pipe immediately follows, and the brakes become automatically applied upon all the cars of the train. The importance of this feature of the automatic brake is very marked. Of all the operations of the air-brake apparatus, the necessity of prompt and reliable action, when the full retarding effect of the brakes is needed, stands pre-eminent. Of all the various manipulations of the air pressure, that of permitting the air pressure in the train pipe to be discharged to the atmosphere is the simplest and most surely attainable. In this way, the prompt response of the brake apparatus, when emergency calls for its operation, is most fully assured, and the automatic air brake has therefore taken a most conspicuous place in the front rank of railroad safety appliances. No accidental disorder of the apparatus can prevent the application of the brakes in emergencies. By means of the engineer's operating valve, or of a valve called the conductor's valve, connected with the train pipe in each passenger car, or by the occurrence of any disorder which dissipates the air pressure in the train pipe, the apparatus automatically causes the train to come to a stop — in the latter case calling attention to the disorder and giving opportunity for such repair as shall again insure safety before the train proceeds.

Power Brakes for Freight Trains.— The automatic air brake was very generally adopted for the passenger trains of all important railroads, and fully met all the requirements of its day. When, however, in the development of railroad transportation, the necessity for the use of an automatic power brake upon freight trains became apparent, new conditions were discovered which the automatic air brake was not qualified to meet. During the year 1886, a series of brake trials was conducted at Burlington, Iowa, by a committee of the Master Car Builders' Association, and it was then demonstrated that the operating requirements of power brakes upon long freight trains could not be fulfilled by any power brake in existence. Prompt and efficient as had been the operation of the automatic air brake upon passenger trains, it was discovered that, upon long freight trains, the required reduction of air pressure in the train pipe to actuate the triple valves at the rear end of the train, occupied too long a period of time, when that reduction was effected only by the discharge of the train-pipe air through the engineer's operating valve. The length of the train pipe upon a freight train of 50 cars is about 2,000 feet, or two fifths of a mile. When, in an emergency, the engineer turned the handle of his operating valve so as to permit the compressed air to discharge from the train pipe to the atmosphere as freely as possible, the movement of the air in the train pipe toward the engineer's valve was so resisted and retarded by friction upon the walls of the train pipe that fully 17 seconds elapsed from the time that the discharge began at the engineer's brake valve until the pressure in the train pipe upon the rear cars became sufficiently reduced to cause the triple valve to operate. The brakes upon the forward cars were promptly applied with full force, so that the speed of the forward portion of the train became materially reduced before the brakes began to apply upon the rear portion of the train. In consequence, the cars of the rear portion of the train plunged forward unresisted into those which were retarded by the brakes at the forward end, with a force that almost equaled that of collision. The shocks produced by such collision were sufficient to seriously damage the cars and their lading.

It was clearly evident that the usefulness of the automatic air brake upon freight trains became contingent upon the discovery of some means whereby the interval of time elapsing between the application of the brakes upon the cars of the forward end and those at the rear end of the train, could be so diminished that no damaging shocks should result from any operation of the brakes. An examination of the conditions of operation made it equally evident that but two methods could be utilized for securing a more nearly simultaneous application of the brakes to all the cars, one of which is to reduce the air pressure in the train pipe so gradually that such reduction is nearly uniform throughout the train, and the other is to provide a series of openings in the train pipe, in addition to that through the engineer's brake valve, so that the train-pipe air may be discharged at different points throughout the train, at approximately the same time. While the first of these two methods proves entirely satisfactory for ordinary applications of the brakes in regular service, so much time is occupied by it that it is wholly unsuitable for applying the brakes when emergencies require prompt and efficient action. The second method, therefore, became the only practical solution of the use of the compressed air brake as an effective safety appliance upon freight trains.

The Quick-Action Air Brake.— This invention, introduced by Mr. Westinghouse about the beginning of the year 1888, was the result of

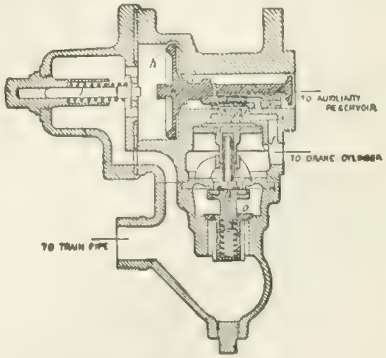


Fig. 3.—Quick-Action Triple Valve.

the development of the principle of venting the train pipe at each car, for quickly applying the brakes. The train pipe is provided with a vent

valve upon each car, which is operated by the mechanism of the triple valve, when, and only when, an emergency application of the brakes is desired. By discharging the air, vented from the train pipe in emergency applications, into the brake cylinder, instead of into the atmosphere, Mr. Westinghouse also discovered that a considerably more powerful and effective application of the brakes could be secured in emergencies than is found to be necessary or desirable for use in the ordinary operations of the brakes in customary service. The mechanism of the quick-action automatic air brake consists of the apparatus hitherto employed in the automatic air-brake system, with the simple addition of the train-pipe vent valve and the means for causing it to operate in emergency applications. A sectional view of the quick-action triple valve is illustrated in Fig. 3.

All of the upper portion of this triple valve is of the same construction as that already described in connection with the automatic air brake, with the single exception that the main slide valve *c* is lengthened at the forward end, and this added portion is supplied with a somewhat restricted port *k*. In all applications of the brakes which result from such moderate reductions of train-pipe air pressure as occur in all ordinary service, this portion of the triple valve is alone operative. The additional quick-action mechanism consists of the supplemental piston *m*, situated in the cylindrical chamber below the slide valve, an emergency valve *n*, with a stem extending upward to the piston, and a check valve *o* directly below the emergency valve. A light spring, situated between the check valve and the emergency valve, serves to support the emergency valve and supplementary piston in the positions shown, under all ordinary circumstances. The port or passageway *p*, indicated by dotted lines, connects the main valve chamber with the chamber above the supplementary piston *m*. This port is normally covered and closed by the slide valve *c*, and is only uncovered when the triple-valve piston *a* moves to the left with sufficient force to compress the supporting spring of the stem *j*, and thereby completes its full traverse to the end of its chamber. When the complete movement of the triple-valve piston thus occurs, the port *p* is uncovered through a notched opening in the lower face of the slide valve *c*, which, however, could not well be illustrated, because of the fact that both it and the dotted port *p* are situated behind the plane of the section shown.

Making a Sudden Stop.— When an emergency occurs, in which the engineer finds it necessary to bring the train to a sudden stop, he moves the handle of the brake valve into a position for quickly discharging the air from the train pipe, whereby a sudden and material reduction of the air pressure is effected in the train pipe upon the first car and in the connected chamber at the left of the triple-valve piston *a*. This results in such a preponderance of air pressure from the auxiliary reservoir upon the right face of the triple-valve piston that the piston is quickly moved to the left, compressing the supporting spring of the stem *j*, until it reaches the end of its chamber. The passageway *p* being thereby uncovered, air pressure from the auxiliary reservoir instantly acts upon the upper face of the supplemental piston *m*, to force it downward and open the emergency valve *n*, as illustrated in Fig. 4.

To clearly comprehend what then takes place, it is important to fully realize the conditions which exist at this instant; they are (1) that no compressed air has as yet, during the practically instantaneous operation above described, entered the brake cylinder from any source; (2) that the compressed air can be discharged from the auxiliary reservoir into the brake cylinder only comparatively slowly, because of the restricted character of the port *k* in the slide valve; and (3) that the air pressure in the train pipe, while having been suddenly and materially reduced below the pressure in the auxiliary reservoir, to the extent of 5 or 10 pounds, or possibly more, is still very considerable (60 or 65 pounds), and it has, by merely lifting the check valve *o*, a capacious and unobstructed passageway, past the open emergency valve *n*, into the as yet empty brake cylinder. In consequence of the existence of these conditions, the check valve *o* is lifted from its seat, against the light resistance of its spring (as indicated in Fig. 4.), and the train-

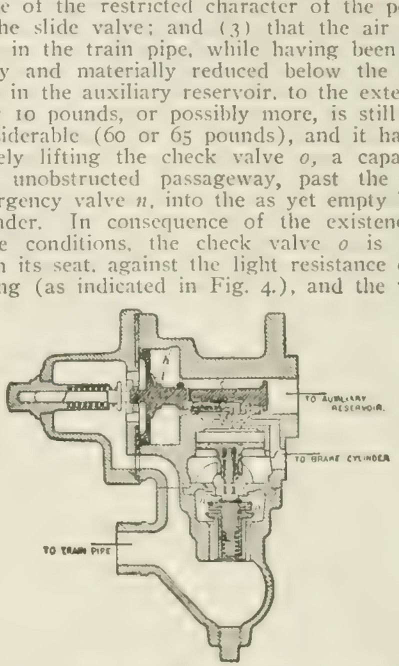


FIG. 4.—Quick-Action Triple Valve, Emergency Valve Open.

pipe air rushes into the brake cylinder, thereby greatly reducing the train-pipe air pressure in the vicinity. When the brake cylinder has become filled with air at the reduced pressure in the train pipe, the spring above the check valve *o* immediately causes it to be closed, cutting off a return of any air from the brake cylinder to the train pipe, as the pressure in the latter becomes further reduced. The air in the auxiliary reservoir, which also has been comparatively slowly discharging into the brake cylinder during the operation just described, now continues to discharge through the port *k* and the passageway *f*, and to add to the contents of the brake cylinder, until equilibrium of pressure exists in the reservoir and brake cylinder.

The sudden discharge of a large quantity of air from the train pipe into the brake cylinder of the first car, not only thus causes a quick and powerful application of the brakes upon that car, but also produces a sudden and material reduction of the air pressure upon the left face of the triple-valve piston *a* upon the second car, thereby reproducing the conditions necessary for the complete movement to the left of the triple-valve piston and a repetition of the operation which occurred in the triple valve of the first car. This operation of the triple valve of the second car similarly actuates the quick-action

triple valve upon the third car, and so on, from car to car, throughout the train. The accomplishment of these successive or serial operations of the triple valves throughout the train occurs with such astonishing rapidity that, whereas 17 seconds elapsed between the application of the old automatic brake upon the first car and the application upon the fiftieth, this interval is but about two and a half seconds in the operation of the quick-action air brake — but little longer than is required for sound to travel through a distance equal to the length of train pipe upon a freight train of 50 cars.

The quick-action automatic air-brake system thus virtually consists of two distinct brake systems — one of moderate power and smooth and gentle application for all the customary operations of every day train service, and the other of high power and violent application for use only when emergencies require most energetic means to avert destruction of life and property. It has practically succeeded all other forms of power brake upon railroad trains, and is now in almost universal use upon the passenger and freight trains in America.

It has already been noted that the condition which determines whether a service or an emergency application of the brakes will result from a reduction of the air pressure in the train pipe, is the rate of rapidity, or the suddenness, with which the reduction of the air pressure in the train pipe takes place. When the air pressure in the train pipe is reduced comparatively slowly, the leftward movement of the triple-valve piston is terminated, by the resistance of the spring supporting the stem *j*, in such a position that the compressed air of the auxiliary reservoir becomes discharged into the brake cylinder, thereby reducing the air pressure of the auxiliary reservoir (which acts upon the right face of the triple-valve piston) co-ordinately with the continued reduction of the air pressure in the train pipe (acting upon the left face of the piston), so that such a preponderance of air pressure upon the right face of the piston, as is necessary to compress the spring of the stem *j*, does not occur. It is only when the air pressure acting upon the left face of the triple-valve piston is reduced much more rapidly than the discharge of auxiliary reservoir air to the brake cylinder will permit the air pressure upon the right face of the piston to be reduced, that the piston makes its complete movement to the left and causes a quick application of the brakes throughout the train. It is necessary, therefore, that the engineer's brake-operating valve shall be provided with such means as shall readily enable the engineer to discharge air from the train pipe with only such rapidity as shall result in a service application, or to discharge the air with such greater rapidity as shall cause the emergency application of the brakes.

It is found also that, inasmuch as it is necessary to elevate the air pressure in the train pipe, as rapidly as possible, to a point somewhat above the pressure of the air remaining in the auxiliary reservoirs after an application of the brakes, in order to force the triple-valve piston to the right and release the brakes, the provision of a stored pressure in the main reservoir upon the locomotive, higher than that ordinarily charged into the train pipe and brake apparatus, is very desirable for temporary use in effecting a prompt release of the brakes. It has thus occurred that the primitive three-way cock, used for an engineer's brake-operating valve in the earlier forms of the air brake, has given place to a more complicated device, now employed for effecting the various operations of the quick-action air brake.

Engineer's Brake Valve.— The functions of the modern engineer's brake valve may be enumerated as follows: To supply air to the train pipe and the auxiliary reservoirs throughout the train, at a certain definitely determined pressure, for the proper operation of the brakes — the standard pressure adopted for this purpose by the railroads being 70 pounds; to discharge air from the train pipe to the atmosphere at such a rate of rapidity that all the applications of the brakes in customary service may be effected without the operation of the quick-action mechanism of the triple valves; to maintain any reduced train-pipe air pressure, resulting from an application of the brakes, so that the brakes may be kept applied with the force corresponding to such reduced train-pipe pressure; to discharge air from the train pipe to the atmosphere with such rapidity, in emergency applications of the brakes, as shall cause the quick-action mechanism of the triple valves to operate with certainty; and to temporarily supply the train pipe with an unusually high air pressure, whenever the brakes

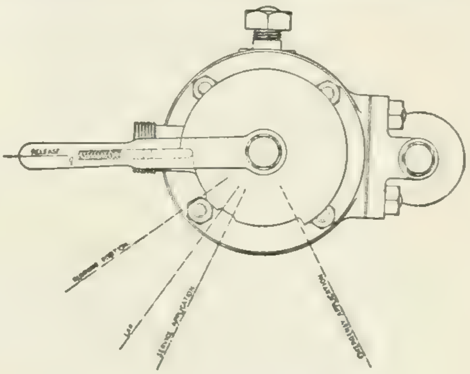


Fig. 5.—Engineer's Brake Valve.

are to be released. These various operations are in practice controlled by different positions of a rotary disk valve, the various positions of which are defined and secured by the movement of a handle operated by the engineer.

In order to avoid confusion, and to more clearly illustrate the construction and operation of the engineer's brake valve, it is somewhat diagrammatically shown, with its ports and passageways so arranged in one plane that a single sectional view of the structure will show them all, except those in the rotary disk valve.

Fig. 5 illustrates a plan view of the valve, showing the handle in the position for releasing the brakes. The other various axial positions of the handle are indicated by dotted lines. Within the handle, there is a latch or pawl, held in position by a coil spring (indicated by dotted lines, and also shown in Fig. 10), which, by engaging with various projections upon a disk, against which the pawl presses, readily indicates to the engineer's sense of touch the various positions of the handle for causing corresponding operations of the brake apparatus.

Fig. 6 illustrates a sectional view of the en-

gineer's valve, with the handle in the running position, in which air from the main reservoir is admitted into the train pipe for the purpose of charging the brake apparatus upon the cars with the proper degree of air pressure. The handle *q* is connected, by means of a spindle, with the rotary disk valve *r*. In the seat upon which the valve *r* rotates, there are shown four passageways. The passageway *e* leads directly to the train pipe; the passageway *z* leads directly to the atmosphere; the passageway *x* leads to the chamber *y* above the piston *u* and the passageway *g* leads to the chamber containing the valve *v*, at the upper end of the structure, called the feed valve. In this feed valve, the small supply valve *u* controls communication between the passageway *g* and a chamber above the piston *t*, which chamber is connected by a passageway *l* with the passageway *e* leading directly to the train pipe. In Fig. 6, the piston *t* and valve *v* are shown in their uppermost positions, being sustained in those positions by the upward pressure of the spring *s*, which upward pressure is properly adjusted by means of the screw plug which supports the lower end of the spring. It is a standard practice upon railroads to charge the train pipe and auxiliary reservoirs upon the cars with air at 70 pounds pressure, and the adjustment of the spring *s* is, therefore, so regulated by the screw plug that an air pressure of 70 pounds per square inch upon the upper face of the piston *t* is necessary to force the piston downward and compress the spring, thereby permitting the valve *v* to be forced to its seat by the light spring pressing upon its upper face.

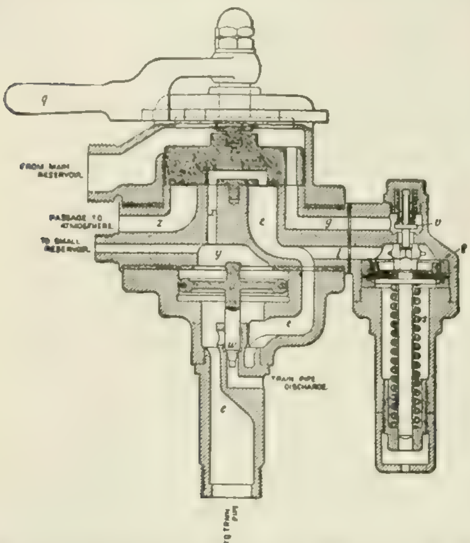


FIG. 6.—Engineer's Brake Valve, Handle in Running Position.

Extending downward from the piston *u*, is a stem which terminates in the poppet valve *w*. The valve *w* normally closes a passageway leading from the train-pipe passageway *e* to the atmosphere. The lower face of the piston *u* is always subject to the air pressure existing in the train pipe, while the upper face is subjected to the variable air pressure in the chamber *y*. Because of the necessarily small volume of the chamber *y*, owing to its position in the midst of a structure which must occupy as small a space as practicable, a passageway leads from it to a small reservoir, which is connected with the structure of the engineer's valve by means of a pipe. In this manner, the chamber *y* becomes a portion of a reservoir or chamber of sufficient volume to permit an accurate reduction of air pressure therein, through the discharge of a portion of the compressed air therefrom to the atmosphere. This small reservoir, which is located in any convenient place, out of the way of the engineer, has, therefore, no other function than to virtually provide such a volume for the chamber *y* as could not otherwise be acquired, without greatly increasing the bulk of the engineer's valve structure, and so rendering it cumbersome and an obstruction in the engineer's cab.

With the handle in the running position, as shown in Fig. 6, the rotary valve *r* is shown in the position in which a passageway through the valve conducts air from the main reservoir to the passageway *g*, leading to the feed valve. The air passes beneath the supply valve *v* into the chamber above the piston *t* and thence by the passageways *l* and *e*, into the train pipe and the auxiliary reservoirs upon the cars. This flow of air from the main reservoir into the train pipe and auxiliary reservoirs continues until they are charged with a pressure of 70 pounds per square inch, whereupon the piston *t* is forced downward, compressing the spring *s* and permitting the supply valve *v* to become seated and cut off further communication between the main reservoir and the train pipe.

The apparatus upon the cars is now charged and ready to apply the brakes, whenever desirable; but the air pump upon the locomotive continues to compress air into the main reservoir, until the latter is charged with an air pressure of about 90 pounds per square inch, at which pressure a pump controlling device, called

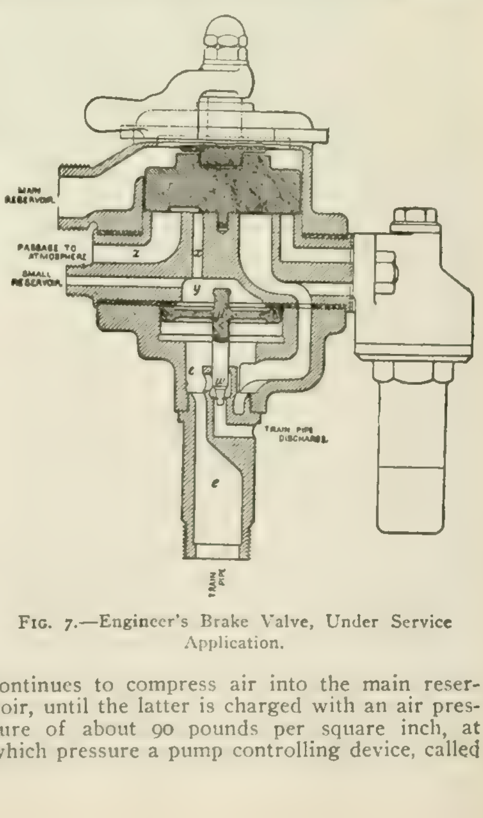


FIG. 7.—Engineer's Brake Valve, Under Service Application.

the pump governor, connected by pipe with the main reservoir, is so caused to operate as to cut off the steam supply to the pump and stop its operation.

It is also to be noted that, in this position of the rotary valve *r*, a passageway is provided which connects the passageways *e* and *x*, so that the chamber *y* and the small reservoir connected therewith are in direct communication with the train pipe and charged with the same air pressure as exists in the train pipe.

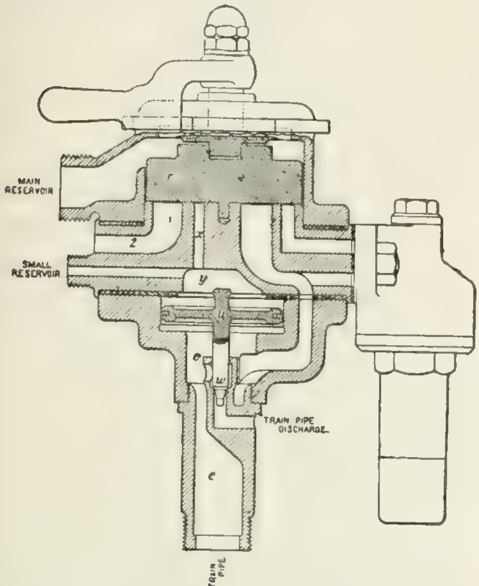


FIG. 8.—Engineer's Brake Valve, Communication Cut Off.

If, while the air-brake apparatus throughout the train is thus charged with the proper air pressure, any reduction of the air pressure should occur through leakage at any part of the apparatus, the effect is to diminish the pressure upon the upper face of piston *t* of the feed valve, thereby permitting the spring *s* to force the piston upward, unseating the supply valve *v*, and so to permit air from the main reservoir to flow into the train pipe and restore the pressure therein, and in the connected auxiliary reservoirs, to 70 pounds. In like manner, a reduction of pressure in the main reservoir, from any cause, acts upon the pump governor to restore the steam supply to the air pump, which replenishes the pressure in the main reservoir and restores it to 90 pounds.

In making a service application of the brakes, the engineer brings his handle into the proper position, thereby moving the rotary valve *r* into a position where the conditions are as illustrated in Fig. 7. In this position of the rotary valve, all communication between the main reservoir and other parts of the apparatus is cut off, and communication between the chamber *y*, above piston *u*, and the train pipe is similarly broken. At the same time, by means of a small cavity in the rotary valve *r*, the passageway *x* is placed in communication with the passageway *z*, so that air from the chamber *y* and the small reservoir connected to it may be discharged into the atmosphere. The immediate effect of reducing the air pressure upon the upper face of piston *u*, while the train-pipe air pressure below the piston remains unchanged, is to cause the piston *u* to be forced upward, thereby unseating the valve *w* and permitting air to be discharged from the train pipe directly to the atmosphere, through the train-pipe discharge passage. The pipe connecting the chamber *y* with the small reservoir is also connected by a branch pipe with an air-pressure gauge, by means of which the engineer is enabled to see how much the air pressure in chamber *y* is reduced by so discharging the air therefrom. When the air pressure in chamber *y* has been reduced to the extent that it is desired to reduce the train-pipe air pressure, the engineer moves his handle into the lap position, thereby bringing the rotary valve into the position illustrated in Fig. 8.

In this position of the rotary valve, all communication between the respective passageways is cut off. The air continues to discharge from the train pipe, through the train-pipe discharge passage, until the air pressure in the train pipe has been reduced to a point slightly below that to which the pressure in the chamber *y* was reduced by discharge of air from the latter chamber to the atmosphere. Thereupon, the preponderance of pressure upon the upper face of piston *u* causes the piston to move downward and reseat the valve *w*, thereby cutting off further discharge of air from the train pipe to the atmosphere. Should the engineer subsequently wish to apply the brakes with a greater force, he again moves the handle of his valve to the position for making service applications and discharges an additional quantity of air from the chamber *y*, to further reduce the air pressure therein. This results in the piston *u* being again

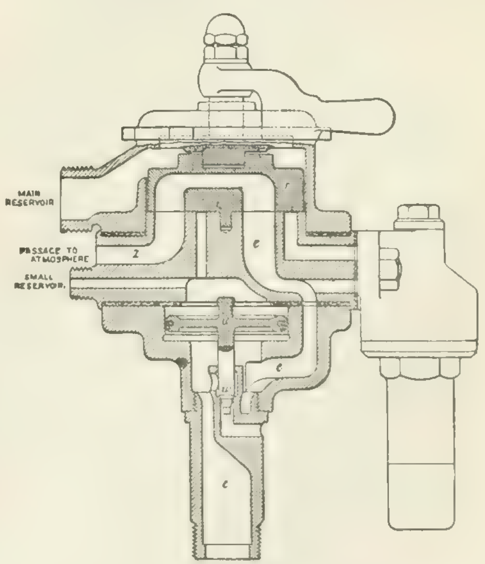


FIG. 9.—Engineer's Brake Valve, Emergency Application.

forced upward, again unseating the valve *w* and further discharging air from the train pipe.

There are two reasons for the interposition of the piston *u* and valve *w*, in this process of

discharging air from the train pipe, instead of discharging it directly to the atmosphere, through a port in the rotary valve *r*, which would appear to be the most natural and simple course. One reason is that, as the number of cars composing a train varies greatly, the length of train pipe of a train of cars likewise varies between wide limits. Upon a short train, the volume of air which must be discharged from the train pipe, to effect a given reduction of air pressure therein, is very much less than the volume which must be discharged from the train pipe of a long train, to produce the same reduction of air pressure. If the air were directly discharged from the train pipe into the atmosphere, therefore, it would be necessary for the engineer to hold the handle of the brake valve

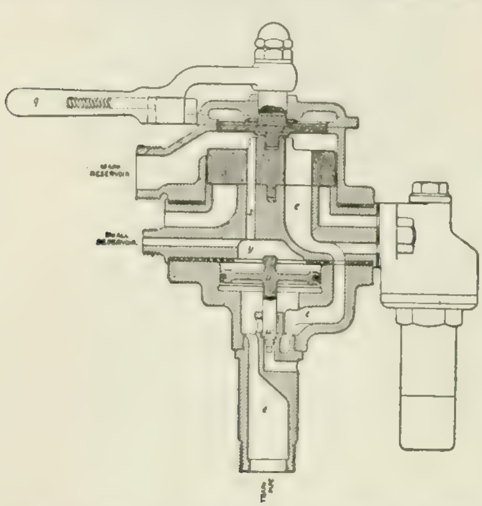


Fig. 10.—Engineer's Brake Valve. Release Position.

in the position for making a service application a different length of time for each different length of train, to cause the same reduction of air pressure; while, with the use of the chamber *y* and connected reservoir, the engineer discharges the same quantity of air therefrom to the atmosphere, upon any length of train, to cause a given reduction of train-pipe air pressure, and the piston *u* remains in its upward position a longer or shorter time, depending upon the length of the train. By this means, the engineer becomes readily accustomed to hold the handle of his brake valve in the service application position the proper length of time to produce any given reduction of train-pipe air pressure, and thus, with experience, he is enabled, with reasonable accuracy, to apply the brakes with the desired force, without the necessity of consulting the pressure gauge.

The other reason for the use of piston *u* and valve *w* is that it is desirable that the discharge of air from the train pipe to the atmosphere shall be gradually and not suddenly terminated. The body of air in the train pipe acquires considerable velocity of movement toward the engineer's brake valve, during the period that the discharge continues, and the sudden termination of such discharge usually results in a temporary increase of pressure at the forward end of the train pipe, sufficient to cause the release of the brakes that have most quickly applied at the forward end of the train. By means of the conical teat below the valve *w*, the downward motion of the piston *u*, which is gradual, is accompanied by a gradual closure of the train-pipe discharge passage, thereby preventing such an increase of air pressure in the forward end of the train pipe, after closure, as would result in causing the release of any of the brakes.

In an emergency application of the brakes, the rotary valve *r* is turned to a position for establishing the conditions illustrated in Fig. 9. By means of a cavity in the rotary valve, the train-pipe passageway *c* is brought into direct communication with the passageway *z*, leading to the atmosphere. The air in the train pipe is thus provided with an unobstructed avenue for discharge to the atmosphere, whereby the train-pipe air pressure is so rapidly reduced as to cause an emergency application of the brakes throughout the train.

To release the brakes, after any kind of an application, the handle of the engineer's brake valve is placed in the release position, in which the rotary valve *r* is brought to a position for effecting the conditions illustrated in Fig. 10. In this position of the rotary valve, communication is established from the main reservoir to the train pipe, through a port leading to the passageway *c*, and to the chamber *y*, by a port leading to the passageway *x*. By this means, the main reservoir air is furnished with an unobstructed passageway to the train pipe, for quickly replenishing the air pressure therein, and the air pressure in the chamber *y* and connected reservoir is simultaneously replenished so as to prevent the increasing train-pipe pressure from lifting the piston *u*. The handle of the engineer's brake valve is customarily left in the release position only long enough to assure the release of all the brakes upon the train when it is turned into the running position, which restores the conditions illustrated in Fig. 6, whereby the train pipe and auxiliary reservoirs are again charged with an air pressure of 70 pounds and are so placed in a condition of readiness for the next application of the brakes.

About the year 1891, the high-speed brake was devised. As long ago as 1876, during some extensive brake trials in England, with apparatus designed and constructed by Mr. Westinghouse and conducted by Capt. Douglas Galton, in behalf of the Institute of Mechanical Engineers of London, it was discovered that the friction between brake shoes and wheels varies greatly at different speeds. The friction of the brake shoes upon the wheels produces a tendency to stop their rotation, while the friction between the rails and the wheels causes the wheels to continue to rotate in spite of the resistance to rotation produced by the brake-shoe friction, and thus the rail friction upon the wheels is what finally and actually retards the motion of the train. In the Westinghouse-Galton brake trials, it was discovered that the rail friction upon the wheels (which is really the friction of rest) is practically the same at all speeds, and the same brake-shoe friction ought therefore to be utilized at all speeds, to produce the best results in stopping. But, as already stated, it was discovered that the friction of the brake shoes continually decreases as higher speeds are attained, and it is therefore very desirable that the brake shoes should be applied to the wheels with

greater pressure at high speed than at low speed, to compensate for the reduced coefficient of friction at the high speeds.

The high-speed brake is designed for the purpose of realizing a greater brake-shoe pressure at high speed, which is subsequently reduced, as the speed of the train declines during the stop, until the pressure has become only such as may be safely maintained until the final stop,

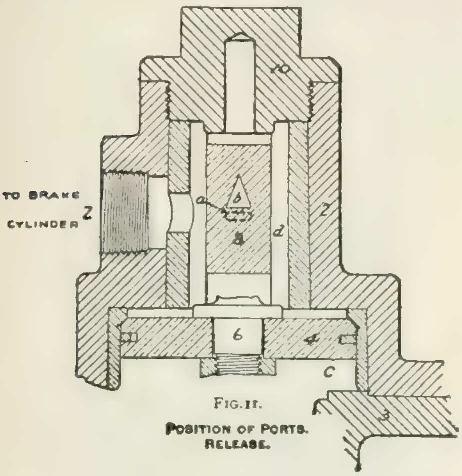


FIG. 11.
POSITION OF PORTS.
RELEASE.

without sliding the wheels upon the rails, it being a well-known fact that the sliding of wheels upon the rails not only seriously damages the wheels but also very materially increases the distance in which the train can be stopped. The apparatus consists of the ordinary quick-action automatic brake apparatus, with the addition of an automatic pressure-

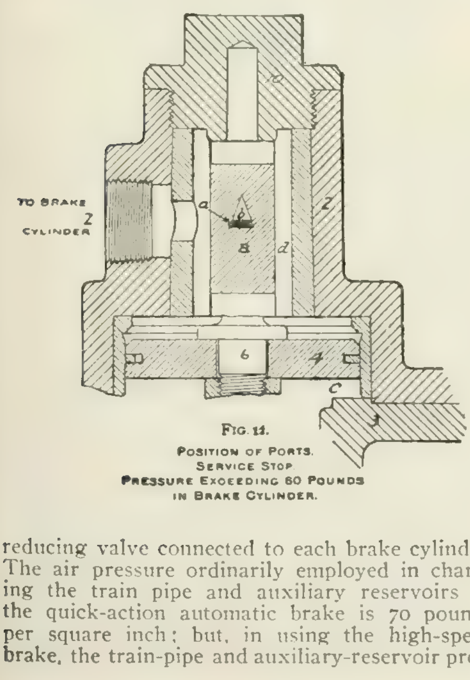


FIG. 12.
POSITION OF PORTS.
SERVICE STOP
PRESSURE EXCEEDING 60 POUNDS
IN BRAKE CYLINDER.

reducing valve connected to each brake cylinder. The air pressure ordinarily employed in charging the train pipe and auxiliary reservoirs of the quick-action automatic brake is 70 pounds per square inch; but, in using the high-speed brake, the train-pipe and auxiliary-reservoir pressure is increased to 110 pounds. In consequence of this increased train-pipe and auxiliary-reservoir pressure, the emergency application of the high-speed brake occurs with a much increased brake-cylinder pressure, which, by means of the automatic reducing valve, is gradually reduced until it becomes only about that which would occur in an emergency application of the ordinary quick-action brake.

It is very important that, in ordinary service applications of the high-speed brake, the brake-cylinder pressure shall not materially exceed that which occurs with the use of the quick-action brake, and it is therefore essential that the automatic reducing valve shall provide such a large release passage for the brake-cylinder air in service applications that the brake-cylinder pressure shall not materially exceed the limit attained with the use of the quick-action brake; but the discharge passage must also be sufficiently small in emergency applications to cause the higher air pressure to accumulate in the brake cylinder and to be discharged only slowly.

These functions of the automatic reducing-valve are obtained by the use of a triangular port opening, the broad base of which exposes

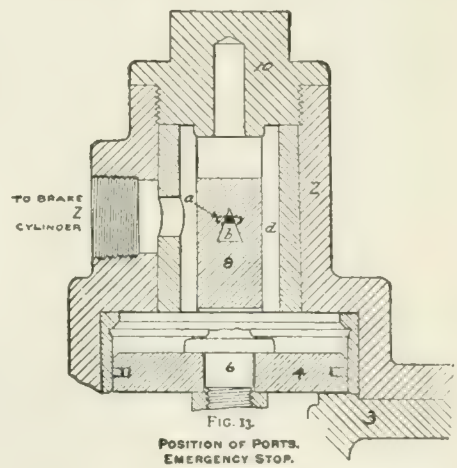


FIG. 13.
POSITION OF PORTS.
EMERGENCY STOP.

a comparatively large opening for releasing any excess pressure in the brake cylinder in service applications, while in emergency applications the valve moves so as to expose the portion near the apex of the triangular port for discharging the air. The arrangement of this port in the reducing valve is illustrated in Figs. 11, 12, and 13, which show the upper portion of the reducing-valve structure. At Z, a pipe connects the reducing valve to the brake cylinder. The piston 4 is thus subjected, upon its upper face, to the air pressure from the brake cylinder, while it is supported at its lower face by a spring, adjusted to hold the piston 4, and the valve 8 attached to it, in the positions shown in Fig. 11, when the brake-cylinder pressure does not exceed that desired in service applications. The slide valve 8 is supplied with the triangular port *b* which, when the pressure in the brake cylinder is less than that for which the spring is adjusted, is in the position shown in Fig. 11, the discharge port *a* in the casing being covered by the slide valve, so that no air

can escape from the brake cylinder. In a service application of the brakes, the brake-cylinder pressure can only comparatively slowly exceed the limit for which the reducing valve is adjusted, and the piston 4 is thereby slowly depressed until the base of the triangular port *b* registers with the discharge port *a*, as shown in Fig 12. In this position of the slide valve, the excess of air in the brake cylinder is rapidly discharged, and the air pressure is thus permitted to but very slightly exceed the limit for which the reducing valve is adjusted.

In an emergency application of the brakes, however, the air pressure in the brake cylinder increases with much greater rapidity than in service applications, and the accumulation of pressure upon the piston 4 causes it to move down more rapidly, bringing the triangular port *b* of the slide valve to register near its apex with the release port *a*, as shown in Fig. 13. In this position of the slide valve 8, the air discharges from the brake cylinder comparatively slowly and the pressure is thus gradually reduced, the piston 4 gradually rising with the reduced pressure, until the pressure has finally become reduced to the limit for which the device is adjusted, when the port *a* is closed and the air pressure then remaining in the brake cylinder continues effective until the train is stopped or the brakes have been released in the customary way by the engineer.

The high-speed brake is now quite generally employed upon the fast passenger trains throughout the United States, and stops trains from speeds of about 60 miles an hour in about 30 per cent shorter distance than the ordinary quick-action air brake.

R. A. Parke,
Expert for Westinghouse Company.

Air-cells, cavities in the cellular tissue of the stems and leaves of plants which contain air only, the juices of the plants being contained in separate vessels. They are largest and most numerous in aquatic plants, as in the *Vallisneria spiralis* and the *Victoria regia,* the gigantic leaves of which latter are buoyed up on the surface of the water by their means. There are also air-cells in the bodies of birds. They are connected with the respiratory system, and are situated in the cavity of the thorax and abdomen, and sometimes extend into the bones. They are most fully developed in birds of powerful and rapid flight, such as the albatross.

Air-chamber, a reservoir in a hydraulic apparatus, in free communication with the water. The chamber or reservoir is filled with air, which by its elasticity diminishes the shocks that would otherwise be produced by sudden changes in the speed of flow of the water, and also equalizes the flow. When the pressure in the pipes is momentarily greater than the normal pressure, water enters the air-chamber and compresses the air it contains; and when the pressure is momentarily less than the normal, the reverse action takes place, and the elasticity of the air forces water back into the pipes.

Air-cock, a cock placed upon a water- or steam-pipe (notably upon a steam radiator) to allow of the escape of air from the piping.

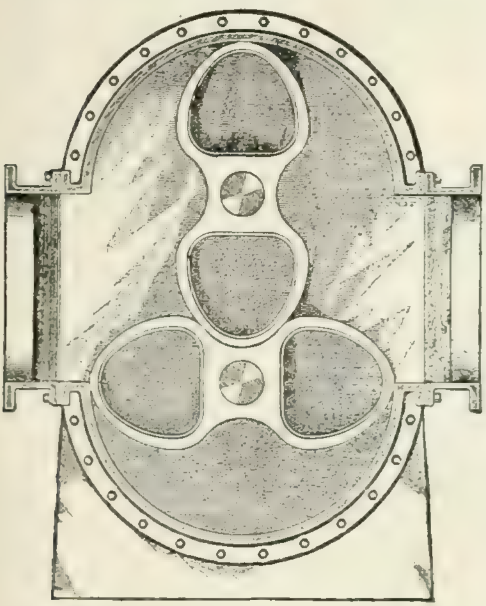
Air-compressors. The various practical applications of compressed air cover a range of pressure from a fraction of an ounce to several thousand pounds per square inch. To produce the required supply of air with proper pressure and economy, numerous types of compressors, each having its peculiar and appropriate field, have been designed. These are, in the order of the pressure produced: the disc fan, the centrifugal blower, the positive blower, the blowing engine, the direct-acting compressor, and the compressor with crank and flywheel. By the operation of all these, the same result is produced — the delivery of a quantity of air under an increased pressure and correspondingly increased temperature, and the subsequent rapid loss by the air of its excess of temperature, with a proportionate decrease in volume. Most of the problems in the design of compressors are created by the heating of the air during compression and by the effects so produced upon the apparatus.

Disc Wheel.

The Disc Fan.—The disc fan, corresponding to the marine screw propeller in action, is useful for producing a flow of air of considerable volume but with almost inappreciable increase of pressure. It is thus suitable for purposes of ventilation in expelling foul air, gases, or smoke, or for removing dust, fine shavings, and waste particles from woodworking and grinding machines. The power expended in revolving the fan goes in great part toward whirling the air current around in the fan casing and pipe — a waste of effort which limits the application of this device to conditions of moderate speed and very light pressure.

The Centrifugal Blower.—By taking advantage of the tendency of revolving particles to fly away at a tangent, a fan blower of better efficiency and a wider field of usefulness is afforded. Particles of air whirled around by the blades of the disc fan merely fly out and press against the casing; but the centrifugal blower converts this action into useful compression through the provision of a spiral casing around the fan, in which the air whirled off by the blades of the fan is deflected and conducted into a discharge pipe leading off from the casing. The blower therefore consists of a fan with radial or sometimes curved blades which stand parallel to the axis instead of obliquely as in the case of the disc fan, and which revolve

in a circular or spiral casing surrounding the fan and opening into a large discharge pipe that leads off at a tangent in any desired direction — up, down, or sideways. Air enters around the shaft of the fan through openings in the centre of the casing, and, being received by the blades, is whirled around and thrown outward into the surrounding chamber with a pressure proportional to the square of the speed of the fan. The pressure thus produced is sufficient for blowing fires of all kinds, for removing small fragments of wood as well as finer particles from wood-cutting machines, for delivering illuminating gas to holders, and for other purposes requiring a pressure of not much over one pound per square inch. The centrifugal blower is the most efficient contrivance known for producing pressures of a few ounces, but its economy falls off very fast if the speed is increased so as to produce pressure as high as one pound per square inch.



Cross-section of Positive Pressure Blower.

This machine seems peculiar in its behavior owing to the fact that it requires less power to maintain a certain speed when the discharge passage is partly closed than when it is fully open. It is evident that when there is no discharge opening, the fan, together with the air between its blades, will spin around freely like any wheel. If the discharge gate be opened, air will flow about the fan blades to their outer ends, and so into the casing and thence to the pipe system; while air from the centre of the fan follows out into the space between the blades, its speed increasing as it approaches the ends of the blades, where it is hurled into the casing. It is the work done in accelerating the motion of these particles of air, which explains the resistance to the movement of the fan; and this work is evidently in proportion to the quantity of air that passes along the fan blades, being zero when, by reason of the closing of either suction or discharge opening, no air is discharged, and being greatest when, with full opening, the volume of air passing is the maximum. The blades of the blower would fly in pieces before the speed could be increased sufficiently to produce an air pressure much over one pound per square inch.

An apparatus identical in principle is the centrifugal pump, which, handling far heavier fluids, produces by centrifugal action pressures measured by pounds instead of ounces.

The Positive Blower.—In direct competition with the centrifugal fan is the positive blower. Consider a fan having opposite blades, revolving in a closed casing, and carrying around with it the air confined between the blades. If a radial partition could be slipped in just after one of the blades had passed, the following blade would compress the air between it and the partition, and would force it out through a discharge pipe if one were provided near the supposed partition. This partition might be imagined to be momentarily withdrawn as each blade passed, so that successive portions of air would be trapped and compressed. The positive blower consists of a fan of this sort, with one or more blades, revolving in connection with an "abutment" performing the office of the partition just alluded to. A well-known form consists of a cylinder carrying two radial blades, and revolving in contact with a cylinder of half the diameter which is provided with a gap of proper form to receive the passing blades. As each blade travels around the casing, it drives the air before it up to the smaller cylinder, whose gap comes around at the proper instant to allow the blade to pass, while intercepting the air continuously. Another type consists of two similar two-leaved cams meshing together like gears, as shown in the sectional illustration.

The positive blower is necessarily made of cast-iron on account of the peculiar shapes required, and its parts are therefore unduly heavy in comparison with their work of compressing air to low pressures. The limit of pressure is not far above that of the centrifugal blower; but as the quantity of air delivered per revolution is practically constant (except for slight leakage), this machine possesses, for certain purposes, some advantages. It is much used for blowing foundry cupolas, moving illuminating gas in gas-works, and for pneumatic-tube transportation.

The Air-compressing Engine.—The air-compressor proper is a cylinder-and-piston machine like the common steam engine. It comprises two sets of valves, usually designed to be opened automatically by excess of pressure under them and to be closed by gravity or by the actions of springs when the pressures become equal. The inlet valves open just after the piston commences its stroke, when the expansion of the compressed air remaining in the cylinder behind the piston has lowered the pressure above the valves. They close at the end of the intake stroke, just as the piston comes to rest. The outlet valves lift during the compression stroke, at about the time the rising pressure in the cylinder becomes equal to that in the outlet passage above the valves; and they close when the flow of air ceases as the piston completes its stroke.

Perfectly correct action of automatic valves is not realized in practice. The valve must

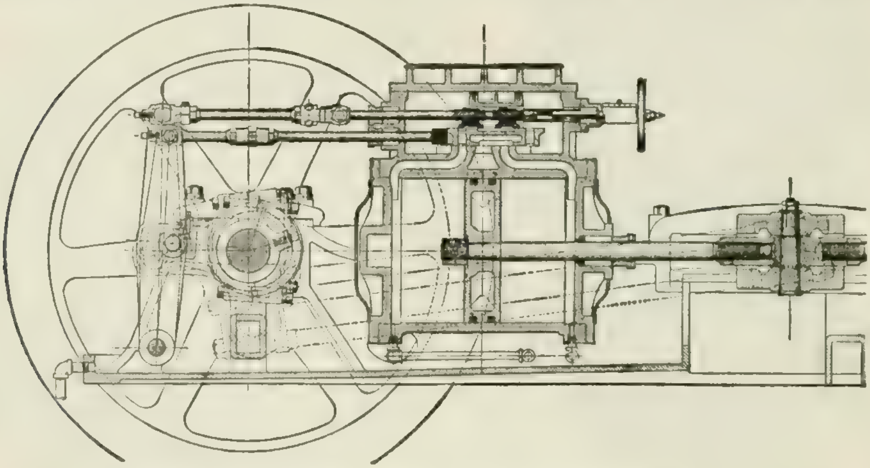
evidently be larger than the opening in its seat, so that the upper surface is larger than the area underneath reached by the lower pressure; consequently the valve will not open until the pressure below is greater than that above. To prevent destructive slamming of the valves, springs must be provided to force them to their seats just as the flow ceases and before the reverse stroke of the piston can cause much backward flow of air. The pressure of the spring acts to choke the flow through the valves, increasing the resistance they offer to the passage of air. Large compressors are therefore often provided with mechanically-actuated valves which are opened and closed smoothly at the proper moment by eccentrics and valve rods. Any of the steam-engine valve gears may be used for compressors, and designed by the same methods, observing only that the compressor is in every way a reversed steam engine, so that its discharge port and valves are duplicates of the inlet details of the engine, while the engine exhaust and the compressor inlet valves are also similarly related.

Varying initial (or boiler) pressure is compensated, except in throttling engines, by varying time of inlet-valve closure or "cut-off"; and varying discharge pressure in a compressor calls for variation in time of opening of the discharge valves. In both cases, the means of variation constitute the chief problem for the designer.

Mechanically-moved inlet valves of compressors act always at the same points, opening a trifle after the piston starts on the intake stroke, and closing exactly at the end of the same stroke; but the discharge valves must open at the instant the piston has compressed the air in front of it to a pressure equaling that above the valves in the discharge pipe, and must close always at the same instant, at the end of the stroke. As the compressor may be working against a pressure greater or less than that regularly carried, the discharge valves must be so controlled as to open at whatever point is required by the pressure then being carried. The requirements are sometimes met by putting automatic lift-valves above, or even directly upon, the mechanical discharge valves, giving the combination the effect of valves automatic as regards their opening, but positively closed by the mechanism at the proper instant. Such lift-valves, being shut off entirely at the proper closing instant, seat themselves without noise or shock, and may therefore have very light springs, causing less resistance to the air passing through.

Where the expense of full mechanical action is warranted on account of the superior efficiency obtainable, poppet or rotary valves may be arranged to open by means of springs or air dashpots. The opening device is released either through the rising pressure in the cylinder easing the valve on its seat, and reducing the friction until the valve, when balanced, slips freely open; or through the same pressure acting on a piston attached to a pusher, the operation of which results either in starting the valve in spite of friction or in lifting a catch and thereby freeing the spring or dashpot mechanism of the compressor.

Compound Compressors.—While low compression pressures are accompanied by only moderate heating of the air during compression, the production of high pressures is attended with excessive heat and considerable increase in the volume of the compressed air. As the air leaving the cylinder soon resumes the normal temperature, and decreases in volume accordingly, the extra work done in compressing the increased volume is wasted. Compressing cylinders in operation are always cooled by water or otherwise; but it is impossible, even by spraying water into the cylinder, to keep the air from rising considerably in temperature. For high pressures, resort is therefore had to compound compression, the air being passed successively through larger low-pressure to smaller high-pressure cylinders, between which are located inter-coolers whose function is to restore the air to its original temperature before it enters on the next stage. The volume of the air is thus kept as small as possible; and the successive stages of compression result in producing the required pressure with a minimum of loss from heating during the process. Two-stage machines are preferred to single-stage where air must be compressed to one sixth or



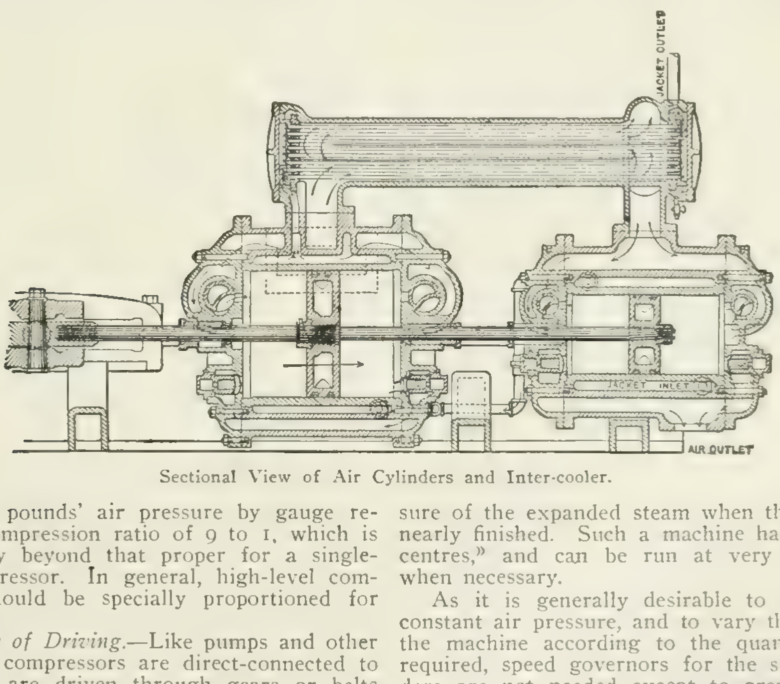
Sectional View of Steam Cylinder of a Typical Air-compressor.

a smaller fraction of its volume at atmospheric pressure (measuring pressures from absolute vacuum); and three or more stages are required in compressing to one sixteenth or less. Cylinder diameters are selected which will provide for about the same amount of work being done in each cylinder.

Most compressor problems deal with air taken directly from the atmosphere at its sea-level pressure; but, as at moderate elevation there is a marked decrease of the atmospheric pressure, compressors for high locations must deal with air at pressures below 15 pounds absolute. Under such conditions the volume of air taken into the compressor at each stroke weighs less, and therefore less air is delivered by the compressor, while there is a corresponding decrease in the power to run the machine. The ratio of compression, and the rise in temperature, are proportionately increased, so that a two-stage compressor may be desirable for pressures that would call for only single cylinders at sea-level. Thus, at many of the mines in the Rocky Mountain region, the atmospheric pressure is as low as 11 pounds per square inch, so that 90 pounds' air pressure by gauge requires a compression ratio of 9 to 1, which is considerably beyond that proper for a single-stage compressor. In general, high-level compressors should be specially proportioned for their work.

Methods of Driving.—Like pumps and other machinery, compressors are direct-connected to engines or are driven through gears or belts from separate sources of power. The reciprocating piston compressor requires a varying effort to balance the cylinder pressure, since, during the stroke, the piston moves against an increasing air pressure, and finally against the full discharge pressure, in pushing out the contents of the cylinder. Direct-connected compressors are either "straight-line" (tandem), having steam and air pistons on the same piston rod, or they are connected to cranks set at an angle on a common shaft. The first method reduces floor space and cost, but requires very heavy fly wheels, and makes the machine liable to stop on a centre if run much below full speed and capacity.

It is evident that steam used expansively supplies against the piston a force decreasing toward the end of the stroke, while air during compression opposes a force increasing toward the end of the stroke; thus the power rapidly falls off as the resistance increases, causing a perceptible reduction in speed at the end of each stroke. If such a machine could be run at high speed, the weight (or more correctly, the mass) of the pistons and connections would, by inertia, help out the decreasing steam pressure when slowing to pass the centres, and thus produce a more even effort on the crank; but sufficiently high speeds are not possible for the automatic-lift valves generally used on small compressors. The varying power and resistance can be very satisfactorily balanced by connecting steam and compressing pistons to separate cranks set at right angles. Having provided two frames and cranks, a slight additional outlay will supply an extra pair of cylinders tandem to the first pair, making a full duplex compressor. The excess steam pressure at the commencement of the stroke of one side is here transmitted by the crank shaft to the other side of the machine, to help out the deficient pressure of the expanded steam when the stroke is nearly finished. Such a machine has no "dead centres," and can be run at very low speed when necessary.



Sectional View of Air Cylinders and Inter-cooler.

As it is generally desirable to maintain a constant air pressure, and to vary the speed of the machine according to the quantity of air required, speed governors for the steam cylinders are not needed except to prevent racing in case of a bursting pipe or other excessive discharge of air. Some form of adjustable cut-off valves is very desirable in order to allow of suiting the work of the steam cylinder to the load. The pressure is controlled by automatic devices actuated by the rise and fall of the air pressure, either shutting off the air intake, opening a by-pass around the compressor piston, or (in case of duplex machines which can start from rest without attention) shutting off steam and stopping the machine.

A description of the standard types of commercial compressors would be incomplete without reference to the most remarkably wasteful "steam eater" known to the compressor trade—a machine using ten times as much steam as

would be necessary for pumping the same amount of air by means of a fairly economical compressor, and yet a device most ingenious and entirely satisfactory for its work. This is the air-brake pump, which, for actual conditions of train service — where it stands idle until the closing of the throttle, and the application of brakes leave a large and heavily fired steam boiler to blow off at the safety valve until the fire can be checked — is seen to be well adapted. Indicator cards show that the entering steam is throttled through about half the stroke, while the exhaust is similarly choked at first and only let out freely about the time of full opening of the valve. The result is a "straight-line" compressor having no crank or flywheel, with nothing moving but its two pistons and one rod, and yet so perfectly balanced between effort and resistance that its strokes are smoothly made at any speed from slowest to fastest, and all with maximum simplicity and minimum weight. These machines are also built with compound steam and two-stage air cylinders, and in these cases have pressures in the cylinders so nearly uniform that the steam distribution may be considerably more economical than it is possible to obtain in the single-stage compressor. See COMPRESSED AIR.

S. H. BUNNELL,
Works Manager, Watertown Engine Company, Watertown, N. Y.

Air Compressors. An air compressor is a device used for compressing air. In itself air lacks the power to do work and serves only as a storer and transmitter of energy. Coal, on the other hand, is a hydro-carbon compound, each element possessing the power to do work when burning. To free the coal of its potential energy it is necessary to apply sufficient heat to begin the operation of burning, and when once started it will continue to give off heat as long as sufficient coal and a sufficient quantity of oxygen are supplied. The burning of coal and the giving up of energy in the form of heat are attended by chemical changes, or changes in the state of matter itself. When air is compressed it has the power to do work by expansion, and as air is expanded the changes in the condition of the air are purely mechanical. Any device which reduces the volume of air with a pressure increase is an air compressor. Air compressors are of two distinct kinds, dry and wet. In the former type a solid piston serves to reduce the volume of air, and in the latter a liquid, usually water, is employed.

Dry or Piston Type.— This is the common form of compressor employed to-day and is widely and extensively used. It consists essentially of a solid shell or cylinder furnished with suitable valves for the admission and discharge of air, and a piston to effect the desired compression. On one stroke of the piston, air is sucked into the cylinder through the inlet valves and when the piston reaches the end of its stroke these valves close just before the piston begins the return stroke. On the return stroke the entrapped air is diminished more and more in volume, with an increase in pressure (and temperature, if compression is not isothermal). At a certain point in the stroke, when a predetermined pressure is reached, the discharge valves open and the compressed air for the remainder of the travel of the piston is forced through the valves into a receiver. When all the air is discharged from the cylinder and the piston begins the return stroke, the discharge valves close and the intake valves again open. Such is, in brief, the operation of an air compressor.

The commercial compressor, however, includes many schemes and modifications to effect the greatest compression with a minimum expenditure of work and trouble. In the practical compressor, the details which receive special attention are main frame, main bearings, air cylinders, air heads, air valves, flywheel, main shaft, crank pins, connecting rod, crosshead, pistons, piston rod, oiling system, bearings, foundation, accessibility, intercooler, governing devices, method of drive, etc. For discussions on these various items, reference should be made to text-books on the subject.

The type of compressor, whether straight line or duplex, single or compound, steam or power driven, depends upon the requirements and natural resources. Following, these points are considered in brief:

Straight Line Compressor.— The straight line compressor is designed to take stresses and strains in direct lines. These machines were originally evolved to meet the demands for compressors which may be easily transported in mountainous countries for distant prospect work, shaft sinking and tunneling operations. Obviously, such service is, almost without exception, hard and continuous. This suggests the question of accessibility and ease in making repairs when no shop facilities are available. The straight line design provides well for all these requirements. Every part of the machine is accessible and an occasional oiling is usually the only attention that such a machine demands. The machine has also been commonly installed in railroad shops for signal work and the like, where absolute reliability in the delivery of compressed air is imperative. For quarrying and also for general contract work this type finds favor. The best straight line machines are built on the lines which a long experience has proved to be the best, that is, power and resistance in straight lines, positive movement of air valves, cold intake air, cooling by a complete surface jacketing, resulting in dry air and effective cylinder lubrication, adjustable steam cut-off for the economical use of steam, small clearance space, automatic speed and air pressure regulation, medium stroke, high rotative speed, extra heavy bearing surfaces for crank pins, shaft and slides, and automatic lubrication. This type of compressor is self-contained and does not require an expensive foundation.

Duplex Air Compressors.— The peculiar requirements of air compressing work are met with in the duplex machine in a manner different from that in the other type just described. In compressing air by means of a reciprocating steam engine the resistance throughout the stroke, due to compression, is inversely proportional to the power in the steam end, that is, at the beginning of compression the pressure is greatest in the steam cylinder and diminishes as the stroke advances, due to expansion of the steam; while the air pressure starts at atmosphere and increases, due to compression.

To equalize resistance and power, no design offers a better solution than the duplex type.

The respective pistons on one side are so adapted, relative to the pistons on the other side, that when one piston is at the beginning of its stroke the other is at the middle of its stroke, whereby the resistance of the air on both pistons is practically equalized throughout the entire stroke.

When steam is the driving fluid, the range of adaptability of the duplex compressor admits of any combinations of duplex or compound steam and air cylinders. The duplex form of construction admits also of installing one side, or the first half, as a compressor complete in itself at a time when the free-air requirement is only one-half of the ultimate demand; the other half may follow later.

Sectional Compressors.— In mountainous regions and in places inaccessible by good roads, where mule-back transportation is the only available means of conveyance, the sectional compressor is employed. Such a machine is so designed that no one section exceeds a given weight limit or proper mule load.

Portable Compressors.— In structural operations where the only air power needed is for driving small machines for operations of a light character and of a shifting nature, the portable compressor outfit possesess many decided advantages. Drilling, chipping and riveting in bridge, railroad, trestle and allied undertakings call for a moderate air supply. It is apparent that the seat of operation is ever changing and that much territory must be covered as the work progresses. The portable compressor is especially adapted for such work. A portable outfit is a complete plant in itself, having boiler, engine, compressor, receiver and the necessary appurtenances mounted on one truck. The plant may be drawn by two or more horses.

Single and Multiple Stage Compression.— Air is compressed in single, two or more stages, depending upon the degrees of compression required. The practical limiting pressure to which to compress air economically in a single stage is about 70 pounds per square inch gauge. Above this point two, three or more stages are employed. Single stage compressors were the earlier forms of machines designed, and are still extensively used for purposes not demanding more than about 70 to 80 pounds pressure. Such machines are used for supplying air to drills, pneumatic tools and the like.

Compound compressors have many advantages over single stage machines. The efficiency, owing to the heat of compression, decreases as the terminal pressure increases, and for pressures above 70 pounds the water jacket of the simple compressor is not sufficiently effective for producing the most economical results; and stage or compound compression is resorted to as the most practical and efficient method for reducing the loss due to the heat of compression. In the compound compressor the cylinder diameters are so proportioned as to divide the work of compression equally between a given number of cylinders. All air cylinders are provided with water jackets and are connected by intercoolers. Free air is admitted to the low pressure cylinder, where it is partially compressed and then forced into the intercooler. The intercooler acts as a receiver and at the same time removes the heat of compression of the intake cylinder before the air is admitted to the second stage cylinder. In the high pressure cylinder (in a two stage machine) the process of compression is completed and the air is delivered to the receiver at the required terminal pressure. The final temperature in each cylinder would be the same if the work was divided equally and the intercooler properly designed, but it will be very much lower than if the compression were done in one cylinder.

To illustrate the difference in effect between single, two or three stage compression, let us take a specific case. Let it be required to compress one cubic foot of free sea level air to 200 pounds gauge pressure, assuming the intake air to be 60° F., and the intercooler process perfect; the ideal or isothermal compression requires 0.1719 horse-power to do the work. The actual or adiabatic work demanded is 0.26 horse-power for single, 0.21 horse-power for two stage, and 0.196 horse-power for three stage compression. Compressing the air adiabatically to 200 pounds gauge pressure in a single stage necessitates a loss of 51.2 per cent. Two and three stage compression occasion losses of 22.2 per cent and 14.0 per cent respectively. The temperature of the air in one stage and at 200 pounds pressure reaches 673° F., while for two and three stage operations 308° F. and 213° F. are the maximum temperatures. The excessive loss in work and the extreme temperature reached in single compression for so high a terminal pressure demand the employment of a compound two or three stage compressor. As mentioned above, for single stage compression 70 pounds gauge is about the limiting economical pressure. The temperature reached in compressing in a single stage to 70 pounds gauge is about 404° F.

The principal advantage of compound compression over simple compression lies in the reduction of the loss due to the heat of compression, which represents, therefore, a saving in power, since the resistance due to compression is directly proportional to changes in temperature.

Intercoolers.— An intercooler is a device used for cooling the air between stages in a compound compressor. It consists essentially of a shell or casing filled with nests of galvanized iron or brass tubes through which cooling water circulates. Baffle plates are provided so that the air passing through the tubes is so distributed with reference to the cooling surface of the pipes that it readily parts with its heat to the cooling water.

The great advantage of compounding is due very largely to the use of intercoolers, and this advantage depends upon the fact that more time is taken to compress a certain volume of air, and that this air during the stages of compression is brought in contact with an efficient cooler. A properly designed intercooler should reduce the temperature of the air back to the original point, that is, to the temperature of the intake air, and even lower if the water is cold enough. The tubes of the intercooler should be placed close enough together that the air when passing through must be split up into thin sheets. These devices are naturally expensive, but first cost is of small moment when compared with the efficiency of the compressor and its effect upon the coal and water consumed.

Steam Driven Compressors.— The air compressors in operation to-day are largely of the steam driven variety, both of the straight line and duplex types. The duplex steam driven machine represents probably the best form of compressor for plants of large size and permanent character. As the economy of a compressor is to a large extent dependent upon the efficiency and economy of the engine to which it is attached, this part of the machine has received special attention and has been developed to the highest point. Three methods of controlling steam admission to the steam cylinders are through slide valves, Meyer adjustable cut-off valves, and Corliss valves. The slide valves are used only on machines of comparatively small capacity and moderate cost, the Meyer on larger and more costly compressors, and the Corliss valves on the largest and most economical machines.

Simple and Compound Steam Cylinders.— Simple steam cylinders are used in installations where the matter of economy in steam consumption is not paramount. Such cylinders are used for steam not over a pressure of about 75 or 80 pounds. In machines demanding the greatest economy and where the steam pressure is high, compound machines are resorted to. Steam is admitted first into the high pressure cylinder where it expands and does work; it is then exhausted into a steam receiver and thence into the second cylinder for further work.

Power Driven Compressors.— The usual conditions under which an air compressor is installed are such as to favor one that is driven independently of any other machinery. Still there are many cases where the independent steam actuated compressor is replaced to advantage with a machine driven from some outside source of power. For instance, from a line shaft by gearing, belt, chain or ropes, from an electric motor, from a gas or oil engine or from an impulse, turbine or other water wheel. In some of these compressors the driving pulley or water wheel is on the main shaft and in others a countershaft is used to advantage, the ratio given frequently being two to one, but generally decided by the peculiarities of each separate case. When sufficient water power is available within several miles of the plant where power is used, this energy may be utilized for compressing air to be piped to the works and there used with great success and economy for pumping, hoisting, drilling and many other purposes. In some few cases power may be converted into electrical energy to advantage, the current so generated being used for driving a number of compressors located close to the seat of operations for driving pneumatic machinery.

Power-driven compressors may be of the simple straight line type or of duplex construction, furnished with single or double acting cylinders. The simple straight line form may be used where the demand for air is light. This machine has the same advantage as the steam-driven straight line machine, in that it takes up stresses and strains in direct lines. Duplex machines are largely for service where the demand for air is considerable. Such machines have the advantage of relieving many of the excessive strains to which the compressor may be subjected by dividing the work equally between the cylinders and counterbalancing impulses. These machines are made with either simple or compound air cylinders, the former being used for sand blast work and the like, where the pressure in no case exceeds the economical limit of 70 pounds. Above this pressure compound cylinders are employed and are provided with a suitable intercooler to remove the heat of compression as the air passes from the low to the high pressure cylinder. The air cylinders are water jacketed, that the valves and moving parts may be kept cool to assist the machine in its proper performance.

The modern power driven compressor driven by gears, by a silent chain, or direct connected to an electric motor or gas engine, operates with efficiency and reliability. The belt driven compressor may be run from a countershaft or from an electric motor, oil or gasoline engine. The gear driven compressor is especially convenient for connecting to an electric motor. The chain driven compressor is built for connection with any kind of motor. Its construction admits of a minimum distance between motor and compressor shaft, so that the least possible space is taken up by the complete machine. The power used for running the belt machine, of course, depends upon conditions. Where there is an existing line shaft driven by a shop engine with surplus power, the best method of drive would probably be a belt, or if the cramped floor space prevents adequate belt centres a rope drive may be preferable, the driving wheel of the compressor being grooved instead of crowned. Again where water power is available a water motor may be used, the conditions of head and quantity of water determining the speed and thus regulating the use of a belt, chain or direct connection. Where the line shafts are not available, the compressor may be operated to advantage from either a gas engine or an electric motor. The selection of either one or the other of these types of machines depends upon the availability of either gas or electrical energy.

Wet or Hydraulic Types of Compressors.— There are three distinct varieties of wet compressors: First, where power is generated by the falling of water; second, where the power is mechanical, ultimately driving a water piston; third, the type in which cooling water is injected directly into the cylinder.

The first is used where there is an abundant water fall and where a high efficiency is not required. The second has the advantage of eliminating entirely the undesirable clearance, as the water used in this instance fills all the dead space not reached by a solid piston. Piston speed is of necessity limited to a low rate due to the mass of water to be moved. As a result, if a large quantity of compressed air is required a multiplicity of compressors must be used. The third is desirable from the point of excellent cooling, but as the fluid used is a poor lubricant, proper lubrication is interfered with which results in a loss of power and increased wear. This variety also has the decided disadvantage of causing compressed air to become very moist, and unless reheating is resorted to before the air is applied to useful purposes it will cause difficulty in cold weather due to freezing. For a more detailed description of hydraulic compressors, reference will

be made to literature on the subject. As a matter of fact, the hydraulic compressor is rarely used, as it is largely impracticable due to lack of efficiency and mainly on account of its cumberousness.

Air Distribution or Transmission.— After the air is compressed it must be properly stored and conveyed and applied to secure all the benefits. For this purpose the aftercooler is important as it serves to reduce the temperature of the air after the final compression, and in doing this it serves as a drier, reducing the temperature to the dew point, thus precipitating moisture before the air is started on its journey. Other important appliances in distribution are receivers, which serve the purpose of reservoir, watertrap and rectifier; pipe lines, for transmitting compressed air from the compressor to the points of application, and reheaters, for heating the air close to the point of admission to the motor.

Application of Compressed Air.— At the present time compressed air is used in almost every art known to man. Its safety, the ease with which it is transported, its simplicity, its applicability to common engines and its use for many different purposes, its economy and the great service it renders in ventilation and cooling are reasons why compressed air is used so extensively. Some of the more important applications of compressed air are for ventilation and heating, air motors, rock drills, quarrying machines, pumps, pneumatic haulage, pneumatic dispatch tubes, pneumatic tools, air jacks, air hoists, air cleaning, etc. See COMPRESSED AIR; PUMPS, COMPRESSED AIR.

EDWARD F. SCHAEFER, M.M.E.,
Ingersoll-Rand Company, New York.

Aird, Thomas, a Scotch poet who has won praise from high critics, but little popular acceptance: b. Roxburghshire, 1802; d. 25 April 1876. He studied in the University of Edinburgh, and formed a lifelong intimacy with Carlyle; contributed to 'Blackwood's,' and won the warm good will of Wilson; edited the *Weekly Journal* 1832–5, and the *Dumfriesshire and Galloway Herald* (Dumfries) 1835–64. He published 'Religious Characteristics,' prose essays (1827); 'The Captive of Fez,' narrative poem (1830); a character story, 'The Old Bachelor in the Scottish Village' (1845), very popular at the time; etc. But he is best (or at all) remembered now for his 'Devil's Dream.'

Airdrie, a municipal and parliamentary burgh, Scotland, in Lanarkshire, 11 m. E. of Glasgow. It depends chiefly on the collieries and iron-works in its vicinity, but has also a large cotton-mill and factory, several extensive foundries and machine-shops, tube-works, and a number of hand-loom weavers. Pop. (1901) 22,288.

Air-drill, a rock drill or other form of drill actuated by compressed air.

Airedale Dog. See TERRIER.

Air-engine, an engine in which air is the working body. Such an engine may be operated by air previously raised to a high pressure by a compressor, as in the storage and transmission of power by compressed air; or it may derive its power directly from the burning of fuel. In the latter case it is often called a hot-air engine. (For the elementary theory of the hot-air engine, see THERMODYNAMICS.)

Aire-sur-la-Lys, ār-sür-lä-lē, a town of France, dept. Pas-de-Calais, 10 m. S.E. of St. Omer. It stands at the junction of the Lys with the Laquette, on a low marshy site, but is well built, and possesses several beautiful fountains, a handsome Gothic church, and barracks for 6,000 men. Its trade is chiefly in linens, fustians, hats, thread, starch, soap, Dutch tiles, osier work, and grain. Pop. (1902) 8,500.

Air-gas, an inflammable gas produced by charging air with the vapors of naphtha, gasoline, or some similar volatile hydrocarbon.

Air-gate, in foundry work, an opening left in the mold for the escape of air and other gases as the molten metal enters.

Air-gun, an instrument for the projection of bullets by means of condensed air, generally either in the form of an ordinary gun or of a pretty stout walking-stick, and about the same length. See ORDNANCE; ZALINSKI.

Air-hole (or **blow-hole**), a fault in a casting, due to the presence of a bubble of air or other gas.

Air-lock, an air-tight chamber used in tunneling, when the tunnel has to be kept filled with compressed air to prevent the entrance of water. The air-lock communicates with the tunnel by one door, and with the outside air by another. It serves the double purpose of permitting the workmen to enter and leave the tunnel without undue loss of air, and of partially mitigating the physiological effects of a too sudden transition from the high pressure in the tunnel to the lower pressure outside.

Air-plant, a popular name for plants that live upon the trunks of trees and obtain their nourishment from air and rain but not from the plants upon which they grow. See EPIPHYTE.

Air-pump, a machine invented by Otto von Guericke about 1652, by means of which air or other gas may be removed from an enclosed space; or a machine for compressing air within an enclosed space: the latter type is usually known, however, as an air-compressor (q.v.). An ordinary suction-pump for water is a rough kind of air-pump; indeed, before water reaches the top of the pipe the air has been pumped out by the same machinery which pumps the water. An ordinary suction-pump consists essentially of a cylinder or barrel having a valve opening from the pipe through which water is to rise, and a valve opening into the outlet pipe, and a piston fitted to work in the cylinder (the outlet valve may be in the piston). (See PUMP.) The arrangement of parts in an air-pump is quite similar. The barrel of an air-pump fills with the air which expands from the receiver (that is the vessel from which the air is being pumped), and consequently the quantity of air expelled at each stroke is less as the exhaustion proceeds. Suppose that the receiver or vessel to be exhausted is exactly as large as the barrel; by the first stroke there is just half the air removed, by the second there is one fourth, by the third there is an eighth, and so on. Suppose the barrel is one third of the receiver as to volume. On raising the

piston the air which filled the receiver now fills both barrel and receiver, so that one fourth is removed at the first stroke, one fourth of the remaining three fourths is removed at the second stroke — that is, three sixteenths, and one fourth of nine sixteenths at the third stroke; the quantity removed at each stroke forming a series of $\frac{1}{4}$, $\frac{3}{16}$, $\frac{9}{64}$, $\frac{27}{256}$, etc.; that is, the total quantity removed is $\frac{1}{4}$ $(1+\frac{3}{4}+(\frac{3}{4})^2+(\frac{3}{4})^3+$ etc.). At each stroke we add a term to this series, and consequently the quantity removed by each stroke becomes smaller and smaller. There are also air-pumps for compressing air — the reverse operation from exhausting air — and a compressing pump may be considered as one of the cylinder pumps above described, but having the receiver connected with the escape valve. There is not so much nicety required in compressing pumps as with exhausting pumps. It may be observed that at the commencement of the stroke the effective pressure against the piston is, we may say, 0, and when it has got to that position where the valve opens toward the receiver the effective pressure is that of the air in the receiver. It will be seen that when the pressure in the receiver is considerable the variation of pressure during the stroke is very great. It is on this account that compression-pumps are sometimes used in which a set of cylinders have their pistons worked by a number of cranks differently set on the same shaft, which shaft also carries a fly-wheel. There is some difficulty in compressing air considerably, from the heating of the pistons and cylinders, when the operation is rapidly proceeded with. Air may be compressed by sending water at pressure into an air-tight chamber containing air.

Many interesting experiments may be made with the air-pump. If an animal is placed beneath the receiver, and the air exhausted, it dies almost immediately; a lighted candle under the exhausted receiver immediately goes out. Air is thus shown to be necessary to animal life and to combustion. A bell, suspended from a silken thread beneath the exhausted receiver, on being struck cannot be heard. If the bell be in one receiver from which the air is not exhausted, but which is within an exhausted receiver, it still cannot be heard. Air is therefore necessary to the production and to the propagation of sound. For the mercury pumps that are used in exhausting incandescent electric lamp bulbs, see VACUUM.

Airship. See AËRIAL LOCOMOTION; BALLOON; FLYING MACHINE.

Air-thermometer, a thermometer in which temperature is measured by determining the change of volume of a mass of air that is kept at constant pressure, or the change of pressure of a mass that is kept at constant volume. See THERMOMETRY.

Air-trap, in steam and hydraulic engineering, a place where air can accumulate in a line of piping; as at the highest point of a line of water pipe. Air-cocks are placed at these points to permit of the removal of the accumulated air. (Also called *air-bond.*)

Airy, Sir George Biddell, an English astronomer-royal: b. Alnwick 27 July 1801; d. 2 Jan. 1892, in Greenwich. He was graduated at Trinity College in 1823. In 1826 he was appointed Lucasian professor of mathematics at Cambridge, a chair once held by Newton, and he was the first actual director of the Cambridge Observatory, holding in connection with this post the Plumian professorship of astronomy. In 1835 he succeeded Pond as director of the Greenwich Observatory, and retained this office till 1881, when he retired on a pension. He initiated at Greenwich the plan of immediately and completely reducing observations; introduced the regular observation of magnetic phenomena, and of sun-spots by photography; invented new instruments for lunar observations; and arranged the British observations in all parts of the world of the transit of Venus in 1874. His chief works were ‹Mathematical Tracts› (1826); ‹Ipswich Lectures on Astronomy› (1849); ‹Undulatory Theory of Optics› (1866); ‹Treatise of Sound› (1869); and ‹Treatise on Magnetism› (1870).

Aisle, in architecture, one of the lateral and usually lower divisions of a building which is divided lengthwise, as by rows of columns or piers, so that the roof is supported while still the interior is one large hall broken only by the uprights. The basilicas of the Romans were built in that way, as had been the small interiors of many Grecian temples; and when the first Christian churches were built in Italy and in the East, this "basilican" form rivaled the round or polygonal plan and the plan of the Greek cross in popularity. At a later time Christian churches were nearly always built with aisles and a higher central part called usually the Nave. Most churches have an aisle on either side of the nave, and are called "three-aisled" churches, but there are a few with five, and the famous Cathedral of Antwerp in Belgium has seven aisles, being almost alone in this respect. It is a mistake to count an outer row of chapels as another aisle.

By extension the term covers such a long and narrow compartment of a building as is found in one of the great mosques of Cairo, Cordova, and Damascus. These buildings have generally flat roofs intended always to be of masonry, and that structure is carried by a great number of parallel rows of columns. The resulting "aisles" are, of course, of the same height. In the mosque of Cordova there are 17 such aisles left open, besides two outer ones which are largely enclosed for chapels: all the aisles opening by doors or windows upon a large court.

Aitkin, Robert, printer and publisher: b. Dalkeith, Scotland, 1734; d. Philadelphia, July 1802. Emigrated to America, 1769; settled in Philadelphia as a bookseller, becoming later a bookbinder and publisher as well. He published the ‹Pennsylvania Magazine› (1775–6), and printed numerous documents and state papers for the Continental Congress, among them the ‹Journals of Congress› from 5 Sept. 1774 to 1 Jan. 1776 (Phila. 1777–80). At his own expense he published in 1782 the first English Bible printed in America. This is now the rarest of all early Bibles printed in America, not more than 25 copies being known to exist. In 1777 Aitkin was imprisoned for his attachment to the cause of independence.

Aivali, AI-vä'li, or **Kidonia,** ki-dō-nī'a (the ancient *Heracleia*), a town of Asiatic Turkey, on the western promontory of the Gulf of

Adramyti, 66 miles northwest of Smyrna. In the beginning of the present century it was a place of considerable note, but in June 1821, during a contest between the Greeks and Turks, it was set on fire by the latter and reduced to ashes. It has again revived, however, and (1902) possesses a population of 35,000. The olive is extensively cultivated in the district, and much oil and soap manufactured.

Aix-la-Chapelle, āss, or āx-lä-shä-pĕl' (German, *Aachen;* Latin, *Civitas Aquensis, Aquisgranum*), capital of a district of the same name in the Prussian province of the Rhine, 38 miles W. by S. of Cologne. It is a well-built town, pleasantly situated in a fine vale watered by the Wurm, and surrounded by the Venn Hills. It was formerly surrounded by ramparts, but these have been converted into pleasant promenades. The town-house (built in 1353 on the ruins of Charlemagne's palace) contains the coronation room with portraits of the German emperors, half-sized portraits of Napoleon and the Empress Josephine, painted by David, and many relics of old German art. The nave of the cathedral, erected by Charlemagne as a palace chapel between 796 and 804, was rebuilt on the old model by Otho III. in 983, after having been almost destroyed by the Normans. It consists of an octagon, surrounded by a 16-sided gallery, and terminating in a cupola. The Gothic choir was begun in 1353 and finished in 1413; it is of prodigious height (114 feet) and lightness, and the large windows are filled with stained glass. Besides the tomb of Charlemagne, the cathedral contains many relics, the most sacred of which — such as the robes worn by the Virgin at the Nativity, the swaddling-clothes of the infant Jesus, the scarf he wore at the crucifixion, etc.— are shown only once in seven years, and attract many thousands of pilgrims from all countries. As the chief station of the Belgo-Rhenish Railway, which connects it with Antwerp, Ostend, and Cologne, Aix-la-Chapelle affords an extensive mart to the commerce of Prussia; it is also a grain market for Belgium, and the seat of commercial and other courts. It was eminent as a manufacturing city, especially of cloth and needles, as early as the 12th century; and its prosperity in this respect still continues. Its woolen cloths are highly esteemed on the continent of Europe and are also exported to America, China, etc. All trading countries, including the United States, have consulates in the city. It is estimated that over 30 per cent of the inhabitants are employed in the manufactures of the city. Although Aix-la-Chapelle is an extensive seat of manufactures and has considerable commercial relations, it derives its celebrity chiefly from its historical associations, and a considerable portion of its importance and prosperity from the influx of visitors to its baths. There are in all eight mineral springs here, six of them warm. The most famous is the Imperial Spring or *Kaiserquelle,* which has a temperature of 143° F., and the vapor of which, when confined, deposits sulphur. For the accommodation of strangers there are a number of bathing-houses. The rooms for bathing are excellently fitted up, with baths from 4 to 5 feet deep, built in massive stone and in the old Roman style. About a half mile north of the city is the Louisberg or Lousberg, rising nearly 300 feet higher than the city. It is a favorite summer evening resort of the citizens.

Aix-la-Chapelle was known to the Romans as early as the time of Cæsar, and is mentioned by Pliny under the name of Vetera. It was, after 768, the favorite residence of Charlemagne, who made it the capital of all his dominions north of the Alps and spared no expense in beautifying it. Here he died in 814, and in the cathedral his tomb is marked by a large flat slab with the inscription *Carolo Magno.* During the Middle Ages it was a free imperial city, and its citizens throughout the empire were exempt from feudal service, from attachment of their goods and persons, and from all tolls and taxes. Thirty-seven German emperors and eleven empresses have been crowned in this city, and the imperial insignia were preserved here till 1795, when they were carried to Vienna, and are now in the imperial treasury. By the peace of Lunéville (9 Feb. 1801), which separated the left bank of the Rhine from Germany, the city was transferred to France, in whose possession it remained till 1814, when it was restored to Prussia. Pop. (1900) 135,221.

Aix-la-Chapelle, Congress of, an important congress held in October and November 1818. By this congress the army of the allies, consisting of 150,000 British, Russian, Austrian, Prussian, and other troops, which, since the second peace at Paris, had remained in France to watch over its tranquillity, was withdrawn after France had paid the contribution imposed at the peace of 1815. Thus the Congress of Aix-la-Chapelle restored independence to France.

Aix-la-Chapelle, Treaties of Peace concluded at. The first, 2 May 1668, put an end to the war carried on against Spain by Louis XIV. in 1667, after the death of his father-in-law, Philip IV., in support of his claims to a great part of the Spanish Netherlands, which he urged in the name of his queen, the Infanta Maria Theresa, pleading the *jus devolutionis* prevailing among private persons in Brabant and Namur. The second peace of Aix-la-Chapelle, 18 Oct. 1748, terminated the Austrian War of Succession in which the parties were at first Louis XV. of France and the Empress Maria Theresa, and, in the sequel, Spain on the one side, and Great Britain, Maria Theresa, and Charles Emmanuel, king of Sardinia, on the other.

Ajaccio, ä-yä'chō, or **Ajazzo,** ä-yät'zō, France, capital of the department and island of Corsica, on its southwest coast, on a tongue of land projecting into the Gulf of Ajaccio. It is sheltered by mountains from the north and east winds; and the town and bay are defended by a citadel. The entrance into the harbor is rendered unsafe by projecting rocks. Ajaccio is the birthplace of Napoleon; the house in which he was born is still in a state of good preservation, and has become the property of the nation. It is the handsomest city of Corsica and the seat of a bishop. It contains a cathedral, a communal college, a public library, a botanical garden, etc. In the commercial world it is famous for its coral and sardine fisheries, and it has also a trade in wine, grain, olive-oil, and fruits. Pop. (1902) 20,200.

Ajalon, said to be the modern Yâlo, a village 14 miles west-northwest of Jerusalem, was the town rendered memorable by Joshua's victory over the five Canaanitish kings, and still more so by the extraordinary circumstance of the miraculously lengthened day.

A'jax (Greek, *Aias*), the name of two of the Grecian chiefs who fought against Troy, distinguished as Ajax Oileus and Ajax Telamonius. The former, the son of Oileus and Etiopas, a Locrian, was called the Less. When the Greeks had entered Troy, Cassandra fled to the temple of Pallas, whence she was forced and dragged along, bound as a captive. Some accounts add that he violated the prophetess in the temple of the goddess. Ulysses accused him of this crime, when he exculpated himself with an oath. But the anger of the goddess at last overtook him, and he perished in the waves of the sea. The other Ajax was the son of Telamon, from Salamis, and a grandson of Æacus. He understood not how to speak, but how to act. After the death of Achilles, when his arms, which Ajax claimed on account of his courage and relationship, were awarded to Ulysses, he was filled with rage, and, driven to frenzy, threw himself on his sword, after having slaughtered the sheep of the Greek army, which he fancied were his enemies.

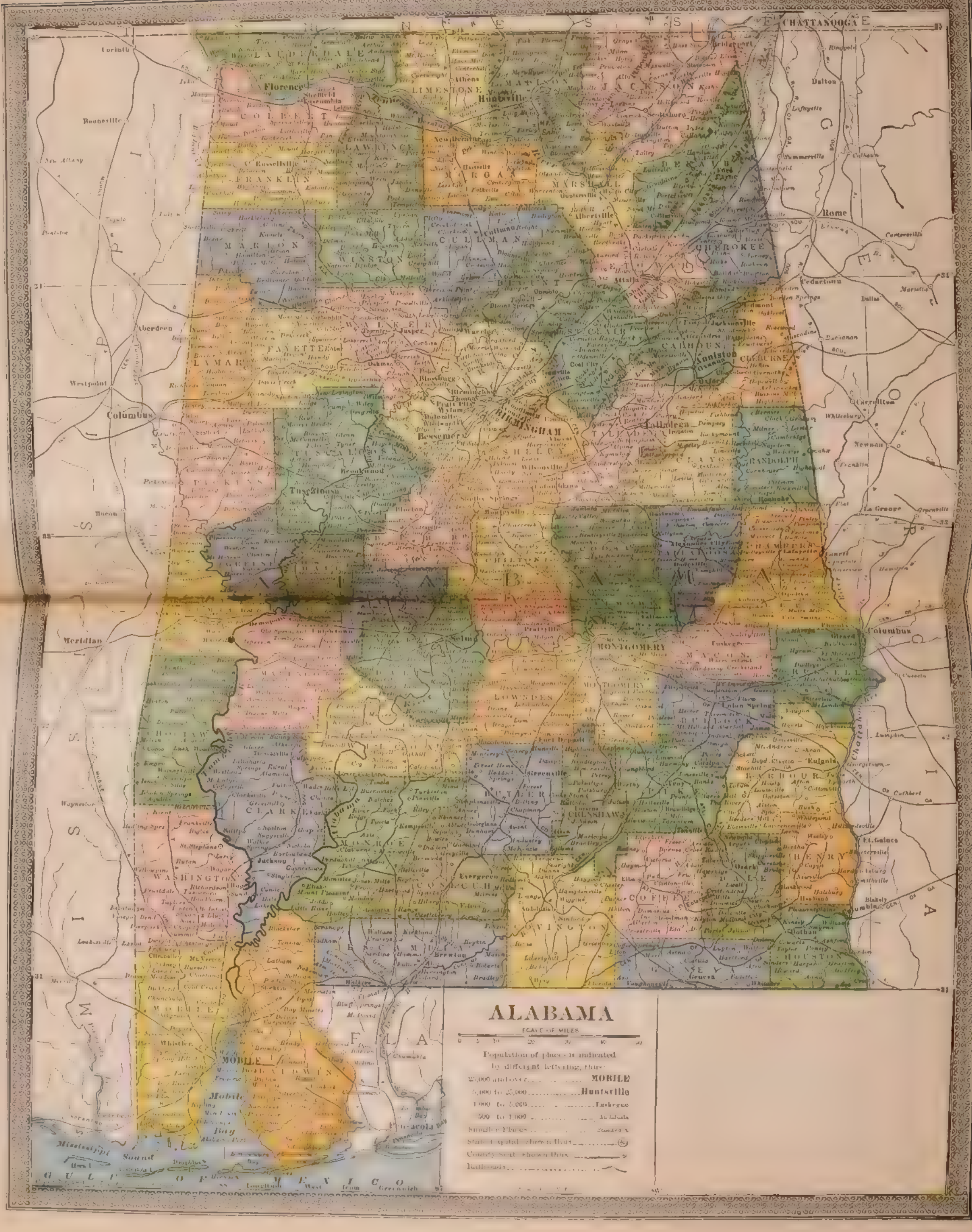
Akron, Ohio, city and county-seat of Summit County, is situated in a range of hills overlooking the Little Cuyahoga River. The Ohio Canal here mounts to the watershed between Lake Erie and the Ohio River by a series of 21 locks. It is 31 miles southeast of Cleveland and 98 miles northeast of Columbus. Railroads centring here are the Baltimore & O., Pennsylvania, Erie, Cleveland, A. & C., Pittsburg & W., Northern O., and Valley. The town was settled about 1818, but its growth dates from the location of the Ohio Canal in 1825, the surplus water used in lockage, furnished by a system of reservoirs on the Summit level, making the power for large flouring mills then located here. It was incorporated as a village in 1836, and as a city in 1871. Its location is advantageous for a diversified industry, being in the northern edge of the grain belt, and on the southern border of the dairy section of the State, and beds of fire-clay and coal fields being close by. It is the principal seat of rubber manufactories for the Middle West, the yearly output of these industries alone being $10,500,000, of which the B. F. Goodrich company furnishes about $6,000,000. The number of rubber workers employed is about 5,000, and the amount paid to them in wages is over $2,300,000 in the year. The printing works of the Werner Company, employing 1,200 persons, are located here. The city is also the seat of a large number of other manufactories, including the American Cereal Company, the Aultman, Miller & Company, makers of Buckeye mowers and reapers, the American Twine and Cordage Company, the American Clay Company, the Akron plant of the Wellman, Seavers-Morgan Company, where is made hoisting and mining machinery, The McNeil Boiler Company, and lesser manufactories of various kinds. At Barberton, the southern suburb of Akron, are the works of the Diamond Match Company, the largest in the world, O. C. Barber, one of the pioneers in this particular industry and founder of Barberton, being a native and resident of Akron. (See BARBERTON.) In addition to its proximity to the coal fields, Akron has facilities for manufacturing in the way of fuel, in natural gas piped from West Virginia. Under the municipal code of Ohio, Akron is governed by a mayor, council, board of public service, board of public safety, board of education, and subordinate officers. The school system alone involves the annual expenditure of upwards of $160,000, and is of a high and efficient grade. Here is the seat of Buchtel College (Universalist), founded by John R. Buchtel, the cornerstone of which was laid by Horace Greeley in 1872. The other principal public buildings are Carnegie Free Library, United States Government building, Colonial Theatre, Grand Opera House, Methodist Episcopal church, High School building, etc. The annual revenue of the city is over $1,000,000. Akron was once the home of John Brown, and his former dwelling is still standing here, where the councils of his associates in the abolition cause were held. It was also the residence of Sidney Edgerton, first chief justice of Idaho Territory, and first territorial governor of Montana. Pop. (1900) 42,728, being a gain of 54.8 per cent since 1890. In 1903 the estimated population was 61,000.

C. R. GRANT,
Attorney at Law, Akron, O.

Alabama, Gulf State of United States (No. 9 in order of admission), bounded N. by Tennessee, S. by Florida and Gulf of Mexico, E. by Georgia, W. by Mississippi; extreme length 336 m., greatest breadth 200 m., about 150 at N. border; area (No. 27 in U. S.), 52,250 sq. m., 710 water; pop. 1900 (No. 18 in U. S.), 1,828,697, or 35.5 to sq. m. (No. 26 in density). Whites, 1,001,152; colored, 827,545.

Topography.— The great Tennessee Valley, which sweeps into and out of the State across the extreme N., is bordered in its western part by a region of fertile terraces; in its eastern it separates the picturesque Cumberland Plateau on the N., a continuation of Middle Tennessee, from the declining flat-topped parallel ranges of the Blue Ridge on the S., which enter the State from N. Georgia some 1,600 feet high, and of which the Raccoon Mountains sink to low hills called the Sand Mountains extending to the centre of the State, while the Lookout Mountains end sharply about 60 miles within it. To the southwest they are succeeded by a low plateau where the great coal and iron deposits lie, to the southeast by the same "Piedmont" region of rolling upland as in all the southern States; and both decline to the great belt of level coastland which extends all around those States and comprises three fifths of Alabama's territory. The sea line is short, three fourths of its natural extent being taken up by Florida; and its only valuable part is Mobile Bay, an inlet 36 miles long by 8 to 18 broad, which receives the great river systems of the State. Other bays are the Perdido, which with the Perdido River divides Alabama from Florida, 20 miles long by 6 to 10 wide, once a nesting-place for pirates and filibusters; the Grand; and the Bon Secours.

River Systems (see also *Commerce and Navigation*, below).— The Mobile system drains the greater part of the State. The Mobile River, 45 m. long, as such, and emptying into the Mobile Bay, is formed from the Alabama E. and the Tombigbee W., very crooked alluvial streams. The Alabama is a powerful stream 800 m. long from its farthest sources, but only so named for the 320 m. from the junction of the Coosa N. and Tallapoosa E., just above Montgomery, the State capital; the Coosa, 350


ALABAMA
SCALE OF MILES
Population of places is indicated by different lettering, thus
MOBILE
Huntsville
Tuskegee
BIRMINGHAM
MONTGOMERY
CHATTANOOGA

m. long as such, is formed by the junction at Rome, Ga., of the Etowah and Oostenaula, and receives N. the Cahaba or Cahawba, rising in the mountains N.E. of Birmingham. The Tombigbee is about 500 m. long; it rises in Mississippi, and just above Demopolis, Ala., receives a large tributary, the Black Warrior, some 300 m. long, wholly in Alabama, rising near the great south bend of the Tennessee at Guntersville. The Tennessee, the Ohio's chief affluent, has about 180 m. of its course in Alabama, with a wholly unrelated drainage system. The S.E. portion of the State is drained by the Choctawhatchie, the Escambia with the Conecuh, and the Chattahoochee which divides the southern half from Georgia, all emptying in Florida.

Climate.— Alabama ranges in climate and products from the temperate to the semitropic regions,— extending from 35° to 30° 10′ N., or within 6⅔ degrees of the Tropic, and from mountain to seacoast; and still more, from northern mountain to southern coast. Parts of its cool northeastern section are noted as sanatoriums; the Piedmont region is entirely salubrious, and near the Gulf the sea winds temper the heat; along the river bottoms it is malarious. There is little snow or sharp cold in the north, nor extreme heat in the south; the mean temperature for winter is 42.9, for summer 83.9; for the year, in the north 59.70, in the south 66.60. The frost limits at Montgomery are 10 October and 25 April. Average rainfall, 54 inches in the north, 63 inches in the south; most of the rain is in early spring, especially in February.

Geology.— All the Appalachian formations are found here, in three geological divisions: (1) Northern, above a line running southeast from the northeast corner to Tuscaloosa, showing Subcarboniferous rock masses and coal measures; (2) Middle, a triangle bounded by above line and one from Tuscaloosa to Columbus, Ga., having metamorphic and calcareous rocks, Silurian sediments, and coal measures; (3) Southern, all below this, having drift beds over Cretaceous and Tertiary rocks. The angle between the Alabama and Tombigbee is rich in fossils.

Soils, Agriculture, and Forests.— Four territorial belts divide the State latitudinally. Each belt is distinguished by a variety of soils, but all soils are productive of forest trees and other wild growths. Each belt is watered in its own degree. Certain staple crops, cotton, corn, the cereals, the legumes, also garden vegetables, orchard fruits and berries, flourish in degree in all the belts. The first is chiefly the Tennessee Valley, with a red chalky soil excellent for grain, and a sheltered situation making fruit culture profitable, even delicate fruit like peaches. The mountainous districts around have much waste land, compensated by water-power, mineral springs, and healing climate; the low foothills, however, are unsurpassed grazing grounds, and the long valleys between the spurs are highly fertile. The mineral lands have generally a sandy soil, often with clay subsoil. The Piedmont region is a rolling prairie of great fertility, the metamorphic rocks having crumbled into varicolored loams with clay subsoil; around it is a forested girdle of similar loam with gravel or sedimentary rock beneath; the cotton belt is part of the famous Southern « Black Belt,» and is a slender strip of black loam sometimes many feet deep, of enormous productiveness, extending across the centre of the State. The southern coast land is sandy, but yields fair returns to labor; much of it is occupied by vast stretches of yellow pine and other woods, affording not only lumber, tar, turpentine, resins, etc., but much wax and honey, and the « pine barrens » are broken by alluvial bottoms in which rice is grown.

The chief crop of the State is cotton, in which Alabama ranks fourth in the Union,— after Georgia, Mississippi, and Texas; in 1899, out of 223,220 farms, 192,388 raised cotton; and out of a total value of all crops of $70,696,268, that of cotton was $42,069,677. The number of bales in that year was 1,106,840; in 1901, 1,103,000, from 3,447,751 acres estimated to be under cultivation. Strong efforts have been made to diversify the State's agriculture more, and not without success; but the system of renting farms by merchants to small occupiers, largely negroes, who are supplied with necessaries by the merchant on a crop mortgage, makes it difficult to effect the change, as the cotton is a less experimental crop than new ones, and the merchant wishes to sell the occupier other products himself. The partial exhaustion of even the fertile cotton land, however, by continuous planting for many years, has awakened much anxiety for the agricultural future; and the planting of cow-pease, alfalfa, etc., to enrich the soil and feed greater quantities of stock, has shown a considerable advance. Next in production to cotton is Indian corn, which is raised on nearly all farms to some extent, and in 1899 amounted to 35,053,047 bushels, with a value of $17,082,271, or nearly one fourth the total of all crops; corn and cotton thus making up nearly six sevenths of the State's crop products. In 1900, a bad year for corn, that crop had fallen to some 29,300,000 bushels. Oats are the next heaviest cereal crops, having of late years crowded out wheat; in 1900 the total output was 4,300,000 bushels against 916,000 bushels of wheat. A more valuable crop is sweet potatoes, of which in 1899 the State harvested 3,467,386 bushels valued at $1,687,039; and little behind it was the production of syrup from sugar cane and sorghum, of which 4,395,235 gallons were made in 1899, bearing a market value of $1,405,278. Peanuts are raised in the southeast. Peaches and melons are important staples. In farm animals the State is not rich, the number of swine being greatest of any, 1,866,000 in 1900.

Minerals and Mining Industries.— The mineral wealth of the State is enormous, practically all of it lying in the northern and middle geological sections. The advantage of vast coal, iron, limestone, and dolomite (magnesian limestone) deposits lying close together has within the past 20 years raised the State from an almost purely agricultural section to one of the chief manufacturing districts of the Union; its centre being Birmingham. It is said that iron products can be manufactured more cheaply there than anywhere else on the globe. The coal fields — all bituminous, but comprising all the highest grades, cannel, coking, gas, etc.— occupy 8,660 square miles; they are named from their rivers, the Warrior, Cahaba, and Coosa. The value of coal mined in Alabama has more than quadrupled in 18 years, rising from less than $2,500,000 in 1886 to over $14,000,000 in 1904, ranking the State No. 5 in quantity and

No. 6 in value in the United States. Besides its direct use and sale, a large part is manufactured into coke, in which Alabama ranks No. 3. The iron deposits so far mined are 72 per cent red and 28 per cent brown hematite, the State ranking second in the latter; magnetic, specular, limonite, and other valuable varieties are also present. The mining of this is almost entirely the development of the past two decades; in 1880 the product was but 171,000 tons; in 1889 it had risen to over 1,500,000 tons, and in 1899 to nearly 2,300,000 tons, making the State third in the Union, next after Michigan and Minnesota — really second, the great Lake Superior beds constituting but one deposit. In export of pig iron it ranks first in the Union. The limestone, used as a flux, and also burned into quicklime, is quarried to the value of above $300,000 a year. Natural gas has been found. Clays are another valuable mineral asset: notably bauxite,— an alumina with some silica and iron, used for making aluminum, alum, and crucibles,— porcelain, fire, and building clays. Building-stone is largely quarried, including a fine sandstone. Among the other of the wonderful mineral riches of Alabama are soapstone and lithographic stone, emery and corundum, asbestos and graphite, slate and asphalt, phosphates and marl, manganese and ochre, gold, silver, copper, and tin. There are mineral springs of note in the north. The marble fields of Talladega County bordering the Coosa River and of Bibb County bordering the Cahaba River are unsurpassed both in abundance of the stone and in its quality. The Italian sculptor, Moretti, whose iron statue, ‹Vulcan,› 54 feet high, was selected to represent Alabama at the Louisiana Purchase Exposition (1904) published his judgment upon practical test that no white marble known to his profession is as valuable to it in the finer grades of work as that which the Talladega quarries afford. These marbles are of many colors.

It has been only of recent years that cement beds have been discovered in the black belt. There is a flourishing manufactory at Demopolis on the Tombigbee and preparations are well advanced (1904) to construct larger plants near Selma on the Alabama. The entire area, 20 miles deep, from Selma to Demopolis, 50 miles, is underlaid with cement rock capable of producing at a cost nowhere else so low, an incalculable supply of Portland cement of the highest classification. Gold mining has (1904) received fresh impetus in the northeastern counties, where the supply is present but the mining yet problematical. The State geologist has published over his signature that the value of the phosphates of the central and southern counties of Alabama to agriculture surpasses the value of the entire coal field to commerce.

Manufactures.— The manufacturing industry of the State as a whole has nearly doubled within the past ten years. By far the greatest increase has taken place in cotton goods, which have nearly quadrupled; an advance due partly to the development of iron industries, the cotton manufacture needing constant facilities for the making and repair of machinery to be profitable. In volume the iron trades far exceed every other. The steel industry is a creation of the past five years mainly; the Alabama ores, from their phosphorus and silica, are unsuited to the acid Bessemer process, but in 1896 manufacturers began to show a preference for the open-hearth steel for which they are fitted. The following table from the census of 1900 shows at a glance the condition and gain of the leading industries:

	Value, 1900	Value, 1890
Iron and steel	$17,392,483	$12,544,227
Lumber and timber products (including turpentine and rosin, value $2,033,705)	12,867,551	8,507,971
Cotton goods	8,153,136	2,190,771
Foundry and machine shop products (iron pipe first, then stoves, car wheels, engines, boilers, etc.)	5,482,441	2,195,913
Railroad cars and car-shop work	4,172,192	1,581,207
Coke	3,726,433	2,474,377
Flouring and grist-mill products	3,310,757	3,060,452
Oil, cottonseed, and cake	2,985,890	1,203,989
Fertilizers (cottonseed meal mixed with Florida phosphates)	2,068,162	765,000
Cotton, ginning	1,218,283	213,529
Leather, tanned, curried, and finished	1,005,358	77,066

The total number of hands employed in these manufactories in 1900 was 37,347, against 20,657 in 1890. It is significant of the trend for consolidation that the number of ironworks was only 25 in 1900 against 35 in 1890; that the coking-works had diminished by 4, and the leather-dressing works by 3. As an instance of the economizing of labor, the flour and grist were turned out by 540 hands against 1,043 in 1890, though there was a considerable increase in value. There were 5,062 establishments altogether in the State, employing $70,370,081 capital and 55,432 hands, and paying $17,299,000 for wages and $46,151,026 for materials; output, $82,793,804. The liberality of the State and of municipalities in exempting cotton mills from taxation for 10 years has exerted a powerful influence upon the growth of that institution. Iron manufactories planted in the suburbs of Birmingham, 20 years ago, with the view of escape from municipal taxes by reason of distance from the corporate lines, are permitted to enjoy their original exemption notwithstanding the city now encloses them by a dense population. The policy of the State Penitentiary in mining coal on its own account with the labor of many hundreds of long term negro convicts, encourages not only manufactures dependent upon steam power, but railroads that transport the products of the mills, to anticipate a steady supply of the fuel. The great saw-mills also receive from the penitentiary a quota of steady and efficient labor.

Commerce and Navigation.— The great streams of the State, never closed by ice, afford fully 1,500 miles regular steam navigation, besides smaller boats in reaches; and improvements under way will increase this. The Mobile River and its two great constituents are navigable to Montgomery on the Alabama, 320 miles from the Mobile (the Coosa has also small steamers on it), and to Columbus, Miss., on the Tombigbee, 300 miles; and the Black Warrior is to be improved and connected with Birmingham by a canal, which will enable products to be carried to Mobile at about one fifth the present cost. The Chattahoochee is navigable to Columbus, Ga., about 300 miles up. The Tennessee's navigation is unfortunately broken by the Mussel Shoals near its western end in the State. On the Gulf the one seaport, Mobile, is a

STATE CAPITOL AT MONTGOMERY.

port of great importance, the outlet of the great river systems of the State; with a heavy trade in cotton, coal, and lumber, and soon to have a vast iron trade also. The bay of Mobile, in 1859–60, with a channel less than 10 feet deep, carried an export trade of $45,000,000, mostly cotton in compressed bales. Lighters were used to receive the cotton at the city wharves, to be towed down the shallow channel to sailing vessels waiting in the lower bay. In 1859 the General Assembly passed a law requiring the county of Mobile to issue $800,000 bonds, the proceeds to deepen the channel. The outbreak of war defeated the plan, subject to the approval of Congress. Under large appropriations of Congress, a channel more than 30 feet deep and with a top width of 280 feet from the Gulf of Mexico to the mouth of Chickasaw Creek, above the city of Mobile, has been successfully opened. The influence of this improvement on the trade of the port, especially in tropical fruits, lumber, and naval stores has been gratifying. The work of deepening the harbor still continues. In 1872 under the direction of the secretary of war, a line of canal was surveyed between Guntersville on the Tennessee River and Gadsden on the Coosa in view of pending legislation to open both of those long rivers to navigation their whole length. The line of canal surveyed was approximately 40 miles and the project was announced feasible at moderate cost.

Fisheries.— These employ about 1,000 men, with an annual catch worth about $150,000.

Railroads and Street Railways.— The railroad system of the State, which in 1850 comprised 183 miles, had increased to 1,843 in 1880, 3,422 in 1890, and 4,316 in 1901, of which 650 were built since 1895, and 118 the previous year; over 4/5 of a mile to every 10 square miles, and over 2.3 to each 1,000 inhabitants. The great railroad centre of the State is Birmingham, which has six trunk lines converging there. In 1901 there were street railway lines in 11 places in the State, operating 216.95 miles of track.

Railroad building began in Alabama at the earliest period in the use of that means of transportation in America. In 1832 the Decatur & Tuscumbia Railroad was chartered, 40 miles long, to overcome the obstacle of the Mussel Shoals in the Tennessee River by connecting the two towns that lay at either end of the shoals. The road was very crude in construction,— bar iron laid on wooden stringers, the cars drawn by mules. The rich planters of the level valley through which the line ran its entire length, built the grade by their slave labor, taking for pay stock in the road. Railroad property has grown to the proportion of approximately 1-6 of the assessable values of the State now taxed. Up to the time of secession, all the stock of the various short lines was owned in the State. Under the effects of a changed banking system, substituting the National Bank of issue, founded on government bonds in lieu of the private bank of issue, regulated alone by the State, founded on farm lands and other personal assets, with gold and silver coin to an ascertained deposit, railroad stocks and bonds are almost exclusively owned in New York and other monetary centres. The State is represented in the practical management of the railroads that penetrate its territory, in so far as domestic traffic is concerned by its own laws enforced by a railroad commission of citizens. The commission is elective at the polls and consists of a president and two associate commissioners, with an office always open at the capitol.

It had been the purpose of the State in ante-bellum legislation, enacted in the last decade of slavery, to connect deep water at Mobile with the landlocked mineral wealth of the central counties by rail. There was a definite policy to add to the export cotton trade then enjoyed by Mobile, an export trade in iron and coal. To this end several lines of railroad were chartered and supplementary assistance rendered in the initial movements to build them to completion by loans in cash taken from the "two per cent" and "three per cent" funds, funds donated to the State by the Federal government from public land sales within her boundaries. The main resources of the projected railroads nevertheless lay in the wealth of slave-owning cotton planters. The results of the war dissipated this reliance and the ownership of the lines as far as completed became promptly absorbed in the North. This change in ownership and control had two inevitable sequences, the operation of the roads in the interest of northern commercial centres as against Mobile, and the rapid extension of the mileage.

State Finances.— The assessed valuation of the State in 1901 was $284,622,937; in 1897, $251,390,135. The State tax was 5½ mills, besides a special soldier and school tax of 1 mill each. The bonded debt in 1901 was $9,357,600; and the interest charge, $448,680. The assessed valuation of the State in 1903 was $307,643,704. The present State Constitution limits the power of the Legislature to levy in any one year a greater rate than 6½ mills on the dollar State taxes. No county may levy a tax exceeding one half of one per centum by State assessment, except to pay old debts. All incorporated cities are subject to the same limitation of the power of taxation that applies to counties. The State can contract no new debt except that the governor may borrow $300,000. The governor has authority under the State Constitution to extend the present bonded debt of the State. The State bonds of all classes are now above par.

Banks.— In 1901 there were 42 national banks, with $4,075,000 capital, $1,883,750 surplus, $17,648,000 deposits, $1,968,000 outstanding circulation; 20 State banks and trust companies, with $992,000 capital and $2,328,400 deposits; 6 savings banks, with unreported deposits; and 34 private banks. The national banks in 1904 had increased to 53 with $22,000,000 deposits; the deposits in private banks then had risen to $17,000,000. The State now has an officer, the bank examiner, on a salary of $2,000 a year, charged with stated and frequent examinations of private banks. Some of the later constructed bank buildings are equal in magnificence of appointments to the best in the United States. The bankers are thoroughly organized.

Education.— The public school system of Alabama was founded on a grant of public lands by the Federal government. The principle underlying the grant is incorporated in the ordinance of 1787, enacted originally by the Congress of the Confederation for the government of the Northwest Territory. It consisted in the donation of the 16th section (640 acres) in each township of government survey to be sold or leased under the State as trustee and the proceeds accruing to be held by the State for the

exclusive benefit of public schools in the township involved. Besides the 16th section for public school support, the same act of Congress donated to the State for the benefit of a university within its bounds a large body of public lands. The lands now known as the "University Lands" are rich in coal seams and are now, although only partially developed, yielding a large supplement to its income from other sources. The 16th section fund yields a partial support to the public schools, while the State pays the university an annual interest amounting to $36,000, by constitutional proviso, on the proceeds of sales of its lands received from Congress made in the earlier history of the State.

In 1875, a State convention repealed the military constitution of 1868 under which the public schools had practically suspended. The military régime had accumulated a public debt which had utterly driven State credit away. Nevertheless the new Constitution prescribed a limit of appropriations for the schools, below which the General Assembly could not reduce the annual sum. In 1901 a State convention again assembled to revise the State Constitution. The Constitution of 1875 prescribed that the public schools should receive from the State not less than $100,000 annually. The Constitution of 1901 so enlarges the limit that the schools now receive about $1,000,000 annually. The Constitution of 1901 ordains methods of procedure under which each county may create a special school fund by taxation. In every enlargement of the public school system the result applies with exact uniformity to the two races who must have separate schools. The question of division of the school fund between the races in ratio of race contribution was raised and elaborately considered in the convention only to be defeated by a decided majority. The youth from 5 to 17 in 1900 were 329,003 whites and 281,348 colored, 610,351 in all; the actual attendance, however, was only 161,884 white and 78,549 colored, 240,433 in all, or less than half the total of white and not much over one fourth the total of colored. There were upward of 7,000 schools and 7,500 teachers, the white and colored being taught separately. Besides these there were 48 public high schools, with about 1,300 scholars; and 66 private secondary schools, with something over 1,000 pupils. There are 7 normal schools aided by the Peabody Fund, 3 of them for colored students, besides 3 private normal schools; 9 agricultural schools for given districts.

The Alabama Polytechnic Institute is the successor to the Alabama Agricultural and Mechanical College at Auburn. The institution is in a highly flourishing condition and is conducted on the military plan. A practical instruction in agriculture and mechanics is given there. Applied science in many features is taught in addition to the usual literary course. There are more than four hundred students there.

The University of Alabama rebuilt entirely from destruction during the War is now open to the coeducation of the sexes. A law department under a dean is maintained in the same grounds for education in the law. At Mobile the medical department for the education of physicians and surgeons is maintained.

There are in the State 9 men's and coeducational universities and colleges, and 9 women's; chief among them are:

Alabama Baptist Colored University (1878). Alabama Conference Female College, Methodist (1855). Athens Female College, Methodist, Athens (1842). Bailey Springs University, non-sectarian, Bailey Springs (1893). Blount College, non-sectarian, Blountsville (1890). Howard College, Baptist, East Lake (1841). Isbell College, Presbyterian (1849). Judson Female Institute, Baptist (1839). Lafayette College, non-sectarian, Lafayette (1885). Lineville College, non-sectarian, Lineville (1890). St. Bernard College, Roman Catholic, Cullman (1892). Selma University, non-sectarian, Selma. Southern University, Methodist, Greensboro (1859). Spring Hill College, non-sectarian, Mobile. Tuskegee Normal and Industrial Institute, colored, Tuskegee (1881). Talladega College, non-sectarian, Talladega. University of Alabama, non-sectarian, Tuscaloosa (1831).

Tuskegee University (q.v.) is of world-wide note for Booker T. Washington's magnificent work in elevating the colored race by industrial training. In March 1901 it had 1,050 pupils from 23 States and Territories, Porto Rico, Cuba, and Africa.

Churches.— The Baptist and the Methodist Episcopal South are the only strong denominational bodies; of the others, the chief are the Presbyterian, Episcopal, and Roman Catholic. There are about 8,000 churches of all denominations.

Charitable and Penal Institutions.— The State maintains an asylum for the insane at Tuscaloosa. It is one of the institutions of the kind that primarily owes its origin to the benevolent spirit of Miss Dorothy Dix of New England. The asylum was opened formally in 1860–1. Dr. Peter Bryce, a young physician, was then made superintendent, and held the position the remainder of his life, some 35 years. The reforms in the management of the insane introduced there by Dr. Bryce are famous the world over. There are State schools at Talladega for the blind, deaf and dumb of both races, the races kept separate. At Birmingham there is a State-supported school for the reform of white boys. At Mountain Creek the State supports a Home for Indigent Veterans of the Confederate Army. The State penitentiary is at Wetumpka, a farm of 700 acres. There is a branch farm of 4,500 acres at Spigners, 10 miles away, and on the Tallapoosa River, five miles in the opposite direction, is a third farm of 1,800 acres. The coal mines in Jefferson County operated by the State employ some 800 convicts. The saw-mills and farmers hire many. At Spigners there is a saw-mill and a cotton-mill. Ordinarily there are 2,500 convicts, 85 per cent negroes. The negro female convicts are perhaps 1 per cent of all; the white female convicts yet fewer. The net income from the penitentiary to the State in 1904 is estimated at $250,000, mostly from the coal mines.

State Government.— The State offices are held for four years, and incumbents are not eligible for re-election, and the governor not for any State office or United States Senate during or within a year after his term. The governor's salary is $3,000 per annum. The Board of Pardons consists of the attorney-general, secretary of state, and state auditor, *ex officio;* its functions are only advisory, as the governor has full power. The latter's veto power extends to

items of appropriation, but a majority vote overrules it, and a bill becomes law without his signature after a week. The legislature meets once in four years, sessions being limited to 50 days; the Senate is limited to 35 members and the House to 105. Members are paid $4 a day and traveling expenses. The statutes must be revised every 12 years; the State may not vote money for internal improvements; and revenue bills cannot be passed in the last five days of a session.

Congressional Representation.—The State has 9 representatives in Congress.

Population and Divisions.—The increase in population has been as follows: 1820, 127,901; 1830, 309,527; 1840, 590,756; 1850, 771,623; 1860, 964,201; 1870, 996,992; 1880, 1,262,505; 1890, 1,513,017; 1900, 1,828,967, an increase of 20.9 for the decade. The foreign-born population was 14,592; colored, 827,545. The colored population is largely concentrated in the "cotton-belt": in 15 selected counties the negro population was 399,397 against 122,040 white, while in 2 of them the proportion is between 6 and 7 colored to 1 white, and in others 4 and 5. The urban population is small: the largest city has under 40,000 people, and only 10 per cent of the population lives in places of 4,000 and over; these places, however, have increased from 10 in 1890 to 16 in 1900, and the negroes crowd into them.

The State has 67 counties, whose names and county-seats are as follows:

Autauga, Prattville.
Baldwin, Daphne.
Barbour, Clayton.
Bibb, Centreville.
Blount, Oneonto.
Bullock, Union Springs.
Butler, Greenville.
Calhoun, Anniston.
Chambers, Lafayette.
Cherokee, Centre.
Chilton, Clanton.
Choctaw, Butler.
Clarke, Grovehill.
Clay, Ashland.
Cleburne, Edwardsville.
Coffee, Elba.
Colbert, Tuscumbia.
Conecuh, Evergreen.
Coosa, Rockford.
Covington, Andalusia.
Crenshaw, Luverne.
Cullman, Cullman.
Dale, Ozark.
Dallas, Selma.
Dekalb, Fort Payne.
Elmore, Wetumpka.
Escambia, Brewton.
Etowah, Gadsden.
Fayette, Fayette.
Franklin, Russellville.
Geneva, Geneva.
Greene, Eutaw.
Hale, Greensboro.
Henry, Abbeville.
Houston, Dothan.
Jackson, Scottsboro.
Jefferson, Birmingham.
Lamar, Vernon.
Lauderdale, Florence.
Lawrence, Moulton.
Lee, Opelika.
Limestone, Athens.
Lowndes, Hayneville.
Macon, Tuskegee.
Madison, Huntsville.
Marengo, Linden.
Marion, Hamilton.
Marshall, Guntersville.
Mobile, Mobile.
Monroe, Monroeville.
Montgomery, Montgomery.
Morgan, Decatur.
Perry, Marion.
Pickens, Carrollton.
Pike, Troy.
Randolph, Wedowee.
Russell, Seale.
St. Clair, Asheville.
Shelby, Columbiana.
Sumter, Livingston.
Talladega, Talladega.
Tallapoosa, Dadeville.
Tuscaloosa, Tuscaloosa.
Walker, Jasper.
Washington, St. Stephens.
Wilcox, Camden.
Winston, Double Springs.

Chief Cities.—The largest place, and the commercial port of the State, is Mobile, with 38,469 population; Birmingham, the Pittsburg of the South, with 38,415 — but Birmingham has a suburban population of peculiar density, numbering of itself quite 75,000, in hourly contact with the city by electric cars. Montgomery, the capital and head of navigation on the Alabama, has 30,346. Anniston, in the Blue Ridge, another iron city and cotton mart, has 9,695; Selma, a cotton centre, on the Alabama below Montgomery, 8,713; Huntsville, in the mountains north of the Tennessee, the emporium of that region and a noted sanatorium, 8,068; Florence, the head of navigation on the lower Tennessee, 6,478; Bessemer, a new iron city, 6,358; and Tuscaloosa, formerly the capital, head of navigation on the Black Warrior, 5,094.

History.—When discovered by white men, the territory was occupied by great Indian tribes of the formidable Muskohegan stock — Choctaws, Creeks, and Chickasaws, Alibamos, and Apalachis. Hernando de Soto (q.v.) found the Indians along the upper Coosa more bountifully supplied with corn and beans and inhabiting better quarters than any of the red men he had found on his way from his landing on the Florida coast. At Mauvila, on his way westward, he found the red men well housed and fed and ready for desperate fighting to resist the invader. The first settlement was by the French under the Canadian Bienville in 1702, at Mobile, where he built Fort St. Louis; the city was founded in 1711, and was the capital of Louisiana for the next 15 years, New Orleans taking its place in 1726. Fort Toulouse was built at the confluence of the Coosa and Tallapoosa in 1714. There were the usual Indian wars and hostilities with the English traders who settled there. When France lost her American dominions in 1763 Alabama was divided at 32° 40′, the northern half being added to Illinois and the southern to West Florida. In 1779 Spain seized the latter, whose British inhabitants had not joined the Revolution, while the United States succeeded to the former. Spain by treaty yielded the territory above 31° to the United States in 1795; for a time it was claimed by Georgia. In 1798 Congress organized Mississippi Territory, with the Mississippi and Chattahoochee as western and eastern limits, the 31st parallel (the present main boundary with Florida) S., and a line from the Yazoo N.; in 1804 the northern boundary was carried to the southern boundary of Tennessee; in 1812 the territory between the Pearl River and the Perdido was annexed to it by proclamation, and in 1813 Mobile was seized and held by Gen. Jackson for the United States. Meanwhile the Lower Creek Indians, instigated by the British, took up arms against the United States and on 30 Aug. 1813 massacred a large party of settlers who had taken refuge in Fort Mims; the Upper Creeks remained loyal, but were involved in the vengeance which overtook the Indians at the hands of Jackson, who crushed them at Talladega and the Horse Shoe Bend of the Tallapoosa. (See JACKSON.) They had to give up their lands west of the Coosa and south of Wetumpka, and were gradually expropriated and finally removed west of the Mississippi. (See CREEK WAR; INDIAN RESERVATIONS.) On 3 March 1817 Alabama Territory was organized, capital St. Stephens; the first legislature met in 1818 at Huntsville. On 14 Dec. 1819 Alabama was admitted to the Union as a slave State, paired with Maine as a free State. In 1820 the capital was changed to Cahaba, in 1826 to Tuscaloosa, in 1847 to Montgomery.

Alabama was one of the earliest of the Southern States to engage in the secession movement, and Montgomery was the first capital of the Confederacy; the ordinance of secession was passed 11 Jan. 1861, 61 to 39. In the

secession convention the black belt influence was dominant, as it had been in the government of the State from the earliest period. The division of the vote on the adoption of the Ordinance of Secession was not between a dis-Union and a Union party. Two methods of dissolving the Union were under discussion, and one or the other method embraced all the delegates of the 100 holding seats, except perhaps a dozen who were unconditional Unionists. William L. Yancey, a lawyer, led the straight separate State secessionists, who were 54 in number. Robert Jemison, a capitalist, led the faction favorable to a co-operation of all the slave States for the purpose of some undefined measure of self-defense against the abolitionists represented by John Brown's invasion; William R. Smith was the representative of the unconditional Unionists. Until the military successes of the Federal government occupied the counties in the northern part of the State, the small farmers there exhibited no reluctance to volunteer in the Confederate army. Forts Morgan and Gaines, which guarded Mobile harbor, were seized; the senators and representatives resigned their seats in Congress 21 January, and on 4 February the government of the Confederacy was organized at Montgomery by delegates from the seceding States. Selma was made a leading Confederate arsenal and shipyard. The Tennessee Valley was occupied by Union forces early in 1862, the fleet in Mobile Bay destroyed, and the forts retaken by Farragut in 1864, and the whole State reoccupied April 1865. A provisional government was established by President Andrew Johnson in June 1865, by the appointment of Lewis E. Parsons, a native of New York who had long resided in Alabama, to be governor. Governor Parsons ordered an election by the full body of electors except the several classes not yet pardoned by the President, of delegates to assemble in the capitol at Montgomery September 1865. This convention made a new State Constitution, revoking the Ordinance of Secession, abolishing slavery, providing for the equality of the freedmen in rights of person and property and ratifying the Thirteenth Amendment to the Federal Constitution. The new Constitution restricted the electorate to the white males eligible. The State government set up by the new Constitution was accepted by all the departments of the Federal government and went into effect December following. The General Assembly, however, refused to ratify the Fourteenth Amendment. Thereupon the Senators and Representatives from Alabama to Congress were denied seats and by the acts of March 1867 the State government was abolished and military rule restored. Under military supervision the Constitution of 1868 was made and a civil government set up. The Constitution of 1868 remained in force until 1875, when a new one was made by the people in convention. The State was bankrupted by the carpet-bag régime, and there was great disorder in the attempt to bring the rule once more into the hands of the better classes; but these conditions have long passed away, and the reorganization of the public debt in 1876 made industrial progress possible. The State is solidly Democratic.

John Witherspoon Du Bose,
Author of 'Life and Times of Yancey.'

Alabama, a river formed near Montgomery, in the State of Alabama, by the junction of the Coosa and the Tallapoosa. It flows west and then south to its junction with the Tombigbee about 50 miles above its mouth, where it assumes the name of the Mobile, and finally falls into Mobile Bay. Steamboats ascend to Montgomery, 320 miles, but the navigation is interrupted during the season of low water. Some of the largest cotton plantations of America are situated on its banks.

Alabama, The, a ship built at Birkenhead on the Mersey by the Lairds under contract with the Confederate States at a cost of $250,000, and sent to sea as a privateer, in the spring of 1862, known as "290." The name indicated only that the vessel was, in order of launch from the builders' yards, number 290. Protest had come to the British government from the American minister at the Court of Saint James, Charles Francis Adams (q.v.), against the sailing of the ship. Meantime Capt. Raphael Semmes and 24 young naval officers from the Confederacy arrived in Liverpool with commissions in their pockets to take command. For sake of prudence Capt. Semmes ordered the "290" to sail for the island of Terceira, one of the Azores, under command of Capt. Butcher, a young officer of the British merchant marine. Semmes immediately followed as a passenger on an English ship. His armament had been already shipped to the same rendezvous. At Terceira the privateer ran up the Confederate colors, took her name as ordered by the Confederate government, and received on board as armament two pivot guns amidships and six 32-pounders, eight guns in all. The manning of the ship was 25 officers in all and about 120 men. Stores for a long cruise were taken aboard, and the vessel, equipped for both steam and sail, entered promptly upon her memorable career. On the night of 11 Jan. 1863, the United States steamer Hatteras engaged the Alabama off the coast of Texas and was sunk. The Alabama roved the seas for two years, seeking the commerce of the United States from both hemispheres. The privateer was supposed to have destroyed one half the American merchant marine, then second in tonnage only to that of Great Britain among the nations. On the forenoon of 11 June 1864 the Alabama made anchor in the port of Cherbourg, France. The intent of Capt. Semmes was to dock his ship for much-needed repairs. While Semmes was awaiting the consent of the Emperor Napoleon III. to the use of the government docks, the news of the arrival of the privateer spread over the land. Capt. Winslow, commanding the United States ship Kearsarge, lying at Flushing, was apprised of the fact by Dayton, United States minister to France, and made for Cherbourg, sailed into the harbor and out without anchoring, but took position outside. Semmes rightly construed the conduct of the Kearsarge as the equivalent of a challenge to combat. The Alabama steamed out on Sunday morning in faultless weather. The Kearsarge's machinery was additionally protected by a chain-armor covered with one-inch deal boards. However, as that part of the ship was struck but twice, the armor was of no material aid. The Kearsarge had 163 men and seven guns; the Alabama 149 men and eight guns. The metal carried by the Kearsarge guns was heavier than the

metal of the Alabama guns. The battle was fought in a circle and lasted 1 hour and 2 minutes, resulting in the sinking of the Alabama. In the first 30 minutes the Alabama lodged a rifled percussion shell near the sternpost of the Kearsarge, which from a faulty cap failed to explode. The shell is now to be seen, in the wood where it buried itself, in the ordnance museum of the navy yard at Washington. Capt. Semmes remained on the deck of his ship until it went down. He and 41 others from the sunken vessel were rescued by the Deerhound, a pleasure yacht belonging to John Lancaster, an Englishman. Many persons had come from Paris to view the battle and the hills along the coast were lined with spectators as it progressed. After the close of the war the British government paid an indemnity to American shippers of $15,500,000, representing losses inflicted by the Shenandoah (in part), the Florida (in full), and the Alabama (in full). Consult: Semmes, 'The Cruise of the Alabama' (1864); Bullock, 'Secret Service of the Confederate States' (1883); Sinclair, 'Two Years on the Alabama' (1895); also the narratives in 'Battles and Leaders of the Civil War' (1887-8), edited by Johnson and Buell. See ALABAMA CLAIMS.

JOHN WITHERSPOON DU BOSE,
Author of 'Life and Times of Yancey.'

Alabama Claims, claims against Great Britain for damages to United States shipping by Confederate cruisers — the Alabama chiefly, also the Florida, Georgia, Shenandoah, and others — built or equipped in British waters during the Civil War, and allowed to depart counter to international law (see DECLARATION OF PARIS; MARQUE AND REPRISAL) and to statutes of both countries obligating their governments to prevent expeditions from their territories against friendly powers. At the outbreak of the War the Confederacy, having no navy, commissioned privateers as of old. Great Britain issued a proclamation of neutrality, according belligerent rights to both and forbidding armament at English hands to either; but the English officials obeyed their superiors' secret wishes and their own sympathies and not their formal orders, knowing they would not be held to account for preventing $1,100,000,000 of English subscriptions to Confederate bonds from becoming worthless. Accordingly English built, stored, and manned vessels soon scoured the seas, capturing and burning United States merchantmen; and English colonial ports, especially Nassau, were safe nests for them for any length of time; while Northern vessels at best were held sternly to the letter of the law, and in some cases illegally imprisoned for many weeks in harbors they had lawfully entered to refit. The least part of the loss was the direct capture of prizes: manyfold greater were the indirect losses caused by the decline in trade from the difficulty in securing freights, the great rise in marine insurance, and greatest of all, the prolongation of the war and its increased cost while it lasted.

The Alabama case, by its flagrancy and Mr. Adams' menace, half frightened and half shamed the English government into amending its conduct, and no more privateers left England; but those afloat heaped up for it a legacy of trouble, of which the United States steadily pressed for a settlement. As early as the winter of 1862-3 W. H. Seward (q.v.) had served notice on Great Britain of a purpose to hold her to account for «negligence,» in diplomatic phrase, in enforcing her laws. From 1865 on there was no cessation in United States urgency of the claims and effort to arrive at some adjustment, including claims for «indirect damages,» above mentioned, which excited the wrath of all parties in England. At last, by the Treaty of Washington (q.v.), 8 May 1871, it was agreed that the «Alabama Claims» (which included those for depredations of other vessels) should be referred to five arbitrators; one to be named by the United States, one by England, and one each by the king of Italy, the emperor of Brazil, and the president of Switzerland; and it defined for their guidance the duties of a neutral and the phrase «due diligence.» The commission met at Geneva, 15 Dec. 1871, and named as chairman Count Federigo Sclopis, the Italian nominee. England sent Sir Alexander Cockburn; the United States, Charles Francis Adams; Brazil, Baron d'Itajuba, Brazilian minister to France; Switzerland, ex-President Jacob Staempfli. The chief English counsel was Sir Roundell Palmer; while the American side was represented by W. M. Evarts, Caleb Cushing, and M. R. Waite (later Chief Justice),— Mr. J. C. Bancroft Davis preparing its case. The decision was given 14 Sept. 1872; for its rules see GENEVA ARBITRATION. Indirect damages were unanimously barred out, on the ground that they were too indefinite to estimate under international law (q.v.); also doubtless for the reason, not openly expressed, that any nation would take its chance of going to war rather than pay such amounts, more than any conceivable war indemnity. England was held liable only for the Alabama (unanimous), Florida (4 to 1), Shenandoah in part (3 to 2), and the tenders of the Alabama and Florida (unanimous); the Retribution failed of inclusion by 3 to 2. The total amount was fixed in a lump at $15,500,000, the United States being left to settle with private claimants. That the total was sufficiently high for the direct losses is shown by the fact that eight years after the establishment of a United States court for distributing it (23 June 1874), claims for only three fifths of it had been allowed. On 5 June 1882 a second court was established to deal with the remainder.

If the award failed to content the extremists on either side,— the Americans too sore from the war losses and bereavements, and the feeling of English foul play which had made «neutrality» a national byword in war time, to give up contentedly all indirect damages; or the English who had lost their investment, and who felt that laws were made to squeeze and stretch according to national sympathies, and that every nation always did so without accountability,— the fact of such a dispute between the two foremost nations of the world being submitted to arbitration advanced enormously the cause of peace in the world (see ARBITRATION), and made a general settlement of national contests without war for the first time a rational forecast instead of a Utopia. By the curious revolution of time, the United States has had more reason to feel its hands tied by the award than England: as the greatest neutral and

trading nation in the world it has most to lose by enlarging the responsibilities of neutrals in time of war.

Alabama, University of, a coeducational (non-sectarian) institution in Tuscaloosa; organized in 1831: Professors and instructors, 50; students, 400; volumes in the library, 25,000; grounds and buildings valued at $300,000; productive funds, $300,000; income, $42,563; number of graduates, 553. The Medical School of the university is located in Mobile.

Alabama Shad. See HERRING.

Alabandite, an iron-black, submetallic mineral. It is usually granular-massive, while its rare isometric crystals exhibit very perfect cubical cleavage. The black color of a fresh surface tarnishes to a dark brown, while its streak is green. Its hardness is 3.5 to 4 and specific gravity about 4.0. Alabandite is a manganese monosulphide MnS, and contains 63.1 per cent of manganese. Some of its most important localities are in Austro-Hungary, Peru, and Mexico. It also occurs in Summit County, Col., and at Tombstone, Ariz.

Alabaster, a name applied to two substances, the one a stalagmitic or stalactitic carbonate of lime, the other a kind of gypsum or sulphate of lime. The first is often called Oriental alabaster, and is that which is mentioned in the New Testament. It occurs in caves in limestone regions, and is a translucent stone of yellowish milky color or of a deeper tinge of yellow, and sometimes marked with lighter and darker streaks like an onyx. It is found in the cave of Antiparos, the Baumann's cave in the Hartz, and is now worked in the province of Oran in Algeria. The gypseous alabaster has a fine granular texture, and is usually of a pure white color. It is softer than the other alabaster, indeed so soft that it may be scooped out with the nails; while the other kind cannot be so treated. It is found in many parts of Europe; in great abundance and of peculiarly excellent quality in Tuscany and Piedmont in Italy, also in England. It is extensively carved into statuettes and vases and often sold as «Florentine marble.» Many museums contain ancient vases and similar articles of alabaster, for which the Romans often employed this material.

Aladdin, or The Wonderful Lamp, one of the stories in 'The Arabian Nights' Entertainments.' Aladdin, the son of a poor widow, comes into possession of a magic ring and lamp, and thus becomes the master of the powerful jinns who are the slaves of the lamp and ring. Through their powers he amasses great wealth and becomes Sultan.

Alagoas, a maritime province of Brazil, deriving its name from various intercommunicating lakes for which it is noted; capital Maceio. It is bounded on the north and west by the province of Pernambuco, on the south by that of Sergipe del Rey, and on the east by the Atlantic; area, 11,640 square miles. This province has several lakes, none of them of great extent, frequented by a great variety of birds; and in the west several ridges of hills, none of them of great elevation, but generally well wooded, and inhabited by abundance of game, ounces, macaws, etc. From the extent of surface covered by lakes and by forests the climate of Alagoas is on the whole moist. The plains near the sea are generally sandy and not very fertile; but inland the soil is good, producing besides tobacco, cotton, and sugar, which are exported to Bahia and Pernambuco, rice, cocoanuts, mangoes, oranges, jack-fruit, and abundance of fine timber used for ship-building in the above-named ports and in Maceio. The forests furnish excellent building and dye woods, and much ipecacuanha. Limestone, granite, and various kinds of clay abound in the province. Pop. (1902) 515,000.

Alajuela, äl-ä-whā'la, a city of the State of Costa Rica, Central America, 23 m. W.N.W. of Cartago, and a little on the western side of the watershed between the Atlantic and the Pacific. It is connected with Cartago by rail. Pop. 16,000.

Alaman, ä-lä-män', **Lucas,** Mexican historian and statesman: b. 18 Oct. 1792; d. 2 June 1853. He was educated in Spain 1814–20, and served as minister of foreign affairs, 1823–5, 1830, 1837, 1853. He introduced European machinery; founded a museum of antiquities and natural history, and was an active official encourager of industry and agriculture, but reactionary in religion and politics. His works are, 'Dissertations on the History of the Mexican Republic from the Conquest to its Independence' (3 vols. Mexico 1844–9), an introduction to his 'History of Mexico,' 1808–30 (5 vols. Mexico, 1849–52), of scholarly impartiality in the main, filled with documentary proofs, but with a tendency to belittle the actions of those not of pure Spanish blood.

Alamanni, or Alemanni, a confederacy of several German tribes which, at the commencement of the 3d century after Christ, lived near the Roman territory, and came then and subsequently into conflict with the imperial troops. Caracalla first fought with them in 211, but did not conquer them; Severus was likewise unsuccessful. About 250 they began to cross the Rhine westward, and in 255 they overran Gaul along with the Franks. In 259 a body of them was defeated in Italy at Milan, and in the following year they were driven out of Gaul by Postumus. But the Alemanni did not desist from their incursions, notwithstanding the numerous defeats they suffered at the hands of the Roman troops. In the 4th century they crossed the Rhine and ravaged Gaul, but were severely defeated by the Emperor Julian and driven back. Subsequently they occupied a considerable territory on both sides of the Rhine; but at last Clovis broke their power in 496 and deprived them of a large portion of their possessions. Part of their territory was latterly formed into a duchy called Alemannia or Swabia, this name being derived from Suevi or Swabians, the name which they gave themselves. It is from the Alemanni that the French have derived their names for Germans and Germany in general, namely, *Allemands* and *Allemagne,* though strictly speaking only the modern Swabians and northern Swiss are the proper descendants of that ancient race.

Alamanni, Luigi, Italian poet: b. in Florence 1495; d. 1556. His father was zealously devoted to the party of the Medici, and he him-

self stood in high favor with the Cardinal Giulio, who governed in the name of Pope Leo X.; but conceiving himself to have been injured he joined a conspiracy formed against the life of the cardinal. The plan was discovered; Alamanni fled to Venice; and when the cardinal ascended the papal chair, under the name of Clement VII., he took refuge in France. But the misfortunes which befell this Pope giving Florence an opportunity to become free, Alamanni returned thither in 1527. His country sent him on an embassy to Genoa. Here he became the friend of Andrea Doria, with whose fleet he went to Spain. Charles V. soon after sailed in the same fleet from Spain to Italy to arrange the affairs of Florence and subject it to the Medici.

After this new revolution, Alamanni, now proscribed by the Duke Alessandro, went to France (1530), where the favors of Francis I. retained him. Here he composed the greater part of his works. The king esteemed him so highly that after the peace of Crespy in 1544 he sent him as ambassador to the Emperor Charles V. Alamanni discharged his office with great skill. He was held in like estimation by Henry II., who also employed him in several negotiations. He followed the court and was with it at Amboise, when he was attacked with dysentery, which terminated his life in 1556. His principal works are ‹Opere Toscane,› ‹La Coltivazione,› ‹Girone il Cortese,› etc. The English poet Wyatt imitated some of his satirical work. The writings of Alamanni are recommended by ease, perspicuity, and purity of style, but often want strength and poetic elevation.

Alameda, ä-lä-mā'da, co-extensive city and township in Alameda co., Cal., on San Francisco Bay and the Southern Pac. R.R.; 11 miles E.S.E. of San Francisco. It is the seat of the College of Notre Dame (Roman Catholic); a popular summer resort, and the place of residence of many San Francisco business men. It has numerous banks, electric light and street railway plants, the largest borax works in the world, extensive potteries, oil refineries, and ship-building yards. The government of the city is vested in a board of four trustees, the president of which is executive head. It has grown from a population of 100 in 1854 to about 18,000 in 1903.

Alaminos, ä-lä-mē'nōs, **Antonio de,** Spanish pilot: b. in Palos, Spain, about the end of the 15th century. He is said to have been with Columbus in 1599, and was the principal pilot for the expeditions of Cordova, Ponce de Leon, and others, in the early part of the 16th century. The earliest map of North America is supposed to have been prepared by Alaminos.

Alamo, ä'lä-mō, **The,** San Antonio, Tex.: a Franciscan mission house built about 1722 and called San Antonio de Valerio; after 1793 used on occasion as a fort and renamed Fort Alamo. It consisted of an oblong plaza some 2½ acres in area, enclosed by walls 8 feet high and 33 inches thick, a church, a hospital building, a convent, and a walled convent yard about 100 feet square. It has enduring celebrity as the scene of the battle and massacre of 6 March 1836, in the war for Texan independence. The fort was held by about 140 men under Wm. B. Travis, and on 23 February was invested by a considerable Mexican army (probably about 4,000) under Santa Anna, who at once began a bombardment scarcely intermitted for the next ten days. The little garrison, compelled to man the defenses day and night, and too few to relieve each other, sent desperate appeals to their outside comrades for help; but to break through the dense Mexican forces was so difficult that the only reinforcement received was 32 men on the 1st of March. At last a breach was made in the walls, and shortly after daylight on the 6th a general assault was ordered. Twice the storming party were repulsed with heavy loss of lives; the third time they gained the parapet and entered the inclosure. No surrender was offered, and the result showed that the Texans knew their foe too well to expect quarter; worn with fatigue and privation, they fought to a finish, till only five were left. These were taken prisoners, and the savage Santa Anna had them slaughtered on the spot. Three women, two white children, and a negro boy were the sole survivors of about 180 inmates. Santa Anna stated the Mexican loss at 70 killed and 300 wounded, but it is believed to have been much greater. The news of the heroic fight, «the Thermopylæ of America,» nerved the Texans in all their future efforts, and their slogan was «Remember the Alamo!» Santa Anna himself was defeated and captured at San Jacinto a few weeks later. (Corners, ‹San Antonio de Bexar,› 1890; Williams, ‹Sam Houston and the War of Independence,› 1893; J. L. Ford, ‹Origin and Fall of the Alamo,› 1896.)

Aland Islands, a group of about 80 islands and islets between the Gulf of Bothnia and the Baltic Sea, and near the mouth of the Gulf of Finland; area, 468 square miles. The principal islands are Aland, which is the largest, and gives name to the group, Lemland, Lumparland, Ekeroe, Fogloe, Kumlinge, Braendoe, Vordoe, and Hannoe. Aland, distant about 30 miles from the Swedish coast, is 25 miles long and about 22 broad. In this island is a harbor capable of containing the whole Russian fleet. The chief towns are Aland and Castelholm. The islands are now included in the province of Finland. Pop. about 19,000.

Alani, or **Alans,** one of the warlike tribes which migrated from Asia westward at the time of the decline of the Roman empire. They are first met with in the region east of Mount Caucasus, where Pompey fought with them. From this centre they spread over the south of modern Russia to the confines of the Roman empire. They were engaged in war with Rome in the time of Hadrian, but were defeated by Arrian, the general of that emperor. Marcus Aurelius had much difficulty in keeping them out of the empire, and Tacitus concluded a treaty with them (275 A.D.). About a century later those on the banks of the lower Danube were conquered by the Huns, after which most of them joined the ravaging expeditions of that people. They accompanied Rhadagais on his march into Italy, and after his defeat they settled first on the Rhine, afterward (about 411) in modern Portugal. Being there completely defeated by the Visigoths, they joined the Vandals, among whom they have become lost to history.

Alanus ab Insulis, a-lā'nus ab in'sū-lis, or **Alain de Lille**, ä-lan' dė lēl, a noted French scholastic philosopher: b. 1114; d. 1203. Of his voluminous theological writings the best known is the treatise on "The Articles of the Faith." His poem, "Anti-Claudinus, or On the Duties of a Good and Perfect Man," is one of the most celebrated poetic compositions of the Middle Ages.

Alarcon, äl-är-kōn', **Ferdinando de**, called El Señor Alarcon, a Spanish general: b. 1466; d. 1540. To his care Francis I. of France was entrusted after his capture at the battle of Pavia. He also took charge of Clement VII. when that pope was taken prisoner by the troops of the Constable Bourbon in 1527.

Alarcon, Hernando, a Spanish navigator: flourished in the 16th century; leader of an expedition to Mexico which set sail in 1540. He proved that California was a peninsula and not an island, as had been supposed previously. He penetrated in boats a considerable distance up the Colorado River. On his return to New Spain he made a valuable map of the California peninsula.

Alarcon, Pedro Antonio de, a distinguished Spanish novelist, poet, and politician: b. in Guadix, 10 March 1833; d. 19 July 1891. His critical contributions to papers, political and literary, his description of the Moroccan campaign, but especially his novels and short stories, are among the best of their kind, and present a picture of modern Spanish society as true to life as it is variegated. His clever essay, 'The Poet's Christmas,' went through over 100 editions. An imposing number of his stories appeared under the collective titles 'Love and Friendship,' 'National Tales,' 'Improbable Stories.' Among them 'The Three-Cornered Hat' and 'The Scandal' deserve special mention.

Alarcon y Mendoza, ä-lär-kōn ē män-dō'thä, **Don Juan Ruiz de**, a noted Spanish dramatist: b. in Tasco, Mexico, about 1588 or 1590; d. 4 Aug. 1639. Little is known about his early life, but he went to Spain in 1600 and became royal attorney in Seville. From 1608 to 1611 he was in Mexico; then he took up his residence in Madrid, where he was appointed reporter of the royal council of the Indies, about 1628. The last great dramatist of the old Spanish school, he may be considered also the creator of the so-called character comedy. Elevated sentiment, harmony of verse, and correctness of language distinguish his works, the principal of which are 'The Weaver of Segovia'; 'Suspicious Truth,' the model for Corneille's 'Liar'; 'Walls Have Ears'; 'The Proof of Promises'; 'The Anti-Christ.' A complete edition of his works was published by Hartzenbusch in Madrid 1866.

Al'aric I., king of the Visigoths: b. about the middle of the 4th century; d. 410, and is first mentioned in history in 394 A.D., when Theodosius the Great gave him the command of his Gothic auxiliaries. The dissensions between Arcadius and Honorius, the sons of Theodosius, inspired Alaric with the intention of attacking the Roman empire. In 396 he ravaged Greece, from which he was driven by the Roman general Stilicho, but made a masterly retreat to Illyria, of which Arcadius, frightened at his successes, appointed him governor. In 400 he invaded Italy, but was defeated by Stilicho at Pollentia (403), and induced to transfer his services from Arcadius to Honorius on condition of receiving 4,000 pounds of gold. Honorius having failed to fulfil this condition, Alaric made a second invasion of Italy, during which he besieged Rome thrice. The first time (408) the city was saved by paying a heavy ransom; the second (409) it capitulated, and Honorius was deposed, but shortly afterward restored. His sanction of a treacherous attack on the forces of Alaric brought about the third siege, and the city was taken, 24 Aug. 410, and sacked for six days, Alaric, however, doing everything in his power to restrain the violence of his followers. He quitted Rome with the intention of reducing Sicily and Africa, but died at Cosenza.

Alaric II., king of the Visigoths from 484 to 507 A.D. At the beginning of his reign the dominions of the Visigoths were at their greatest extent, embracing three fourths of the modern Spain and all western Gaul to the south of the Loire. His unwarlike character induced Clovis, king of the Franks, to invade the kingdom of the Visigoths. In a battle near Poictiers (507) Alaric was slain and his army completely defeated. The 'Breviarium Alaricianum,' a code of laws derived exclusively from Roman sources, was compiled by a body of Roman jurists at the command of this King Alaric.

Ala-Shehr, ä-lä-shār', ancient Philadelphia, a town in Turkey in Asia, 76 miles east of Smyrna, famous as the seat of one of the first Christian churches, and still having a vast number of interesting remains of antiquity, consisting of fragments of beautiful columns, sarcophagi, fountains, etc. It is a place of some importance, carrying on a thriving trade, chiefly with Smyrna, to which runs a railway. Pop. 19,000.

Alaska, Inuit al-ak-shak or al-ā-ek-sa, "great land," formerly Russian America; a Territory of the United States, the N.W. extremity of the continent; bounded N. by the Arctic Ocean, S. by the Pacific Ocean, E. by Canada (Yukon District and British Columbia), W. by the Arctic Ocean, Siberia, and the Bering Sea. Lat. 54° 40' to 71° 30' N.; lon. mainland 141° to 167° 59' 12" W., to the farthest island (Attoo) about 187°. Length, mainland about 1,150 m., Aliaskan Peninsula and islands 1,500 m. (as far west of San Francisco as Maine lies to the east); breadth N. to S., about 850 m.; coast line, about 8,000 m.; area, 590,884 sq. m. Pop. (1900) 63,592 (for items see *Population*, below); (1902) about 90,000. Capital, Sitka (formerly New Archangel), in the extreme southeast.

Size of Alaska.— For many reasons, but chiefly because of its distance from the United States and the present difficulties of travel in its interior, the size of the territory has been but little understood and probably much underestimated. The mere statement that the area of Alaska is nearly 600,000 square miles will give but a vague idea of its vast extent. If it were possible to take the whole territory of Alaska and its adjoining islands and place them upon the portion of North America occupied by the

ALASKA
SCALE OF MILES
Population of places is indicated
by different lettering, thus
3,000 and over DAWSON
1,000 to 3,000 Sitka
500 to 1,000 Douglas
100 to 500 Auvik
Smaller places Katwok
Railroads
ARCTIC OCEAN
ASIA
GULF OF ANADIR
BERING SEA
ALASKA
GULF OF ALASKA
PACIFIC OCEAN
YUKON
MACKENZIE
DOMINION OF CANADA
BRITISH COLUMBIA
NOME
DAWSON
SKAGWAY
Sitka
Juneau
Mt. McKinley
Mt. St. Elias
Mt. Logan
Norton Sound
Kotzebue Sound
Bristol Bay
St. Lawrence I.
Pribilof Islands
Aleutian Islands
Fox Islands
ARCTIC CIRCLE
East Cape
C. Prince of Wales
FROM JUNEAU to FORTY MILE CREEK
Continuation of ALEUTIAN IS.
Same Scale as Main Map
Near Islands
Longitude West
Copyright, 1903, by The Americana Company

United States, it would be a simple thing to show exactly the proportionate size of this great possession. This, in effect, has been done, as the accompanying illustration demonstrates. The chart was prepared by Mr. Alfred H. Brooks of the United States Geological Survey. It shows that the Territory of Alaska is sufficient in geographic extent to reach from the Atlantic to the Pacific and from Canada to Mexico. Placed in this position on the United States, Alaska would cover 23 States and Territories and the western third of Lake Superior.

Topography.— Alaska consists of: (1) A squarish block with the oceans on all sides but the east. (2) A strip of mountain coast 50 to 75 m. wide, for some 500 m. further southeast, the last 300 m. fenced from the ocean by a wonderful maze of 1,100 forested mountainous islands called the Alexander Archipelago, 13,000 sq. m. in area, and separated by glacier-cut channels variously styled sounds, straits, canals, entrances, inlets, etc. They are divided from the mainland N. by Cross Sound,— the ocean opening of the great Klondike route, where the fiord Lynn Canal, an inlet about 100 m. long, leads to passes over the mountains,— the beginning of a striking physical change, where the St. Elias Range and the greatest glaciers begin and the greatest forests end; and from Queen Charlotte Islands (Canadian) by Dixon Entrance. The chief of these islands are (from the north) Chicagof, Admiralty, Baranof (containing Sitka), Kulu, Kupreano, Zarembo, Prince of Wales (the largest), and Revillagigedo. (3) To the southwest the Aliaska Peninsula, about 450 m. long, and a chain of some 150 islands, 31,000 sq. m. in area (the Aleutian Islands or Archipelago) over 1,000 m. further, nearly to Kamchatka. Bering's and Copper islands, near the Siberian coast, belong to Russia. They are divided into groups, known as the Fox (the first of which, Unimak, is the largest of the archipelago), the islands of Four Mountains, the Andreanof, the Rat, and the Near islands. The southern part of the main body is a vast concave called the Gulf of Alaska, its two arms the southeast coast and Aliaska; the latter divided from the north mainland by Bristol Bay, and nearly made an island by the great Iliamna Lake, the Nikhkak "loch" N.E., and their river outlet S.E. To the east, but physically belonging to the first division, is the important Kenai Peninsula, divided from it and the mainland by Cook's Inlet, nearly cut off by Turnagain Arm, and separated on the east by Prince William Sound. Half the western side is taken up by a deep concavity, its cusps being Cape Romanoff on the south, and Point Hope and Cape Lisburne to the north. From its centre projects the huge tooth-shaped Seward Peninsula, divided from Siberia by Bering Strait; the western extremity being called Cape Prince of Wales,— only 48 m. from East Cape (the extremity of the Kamchatka Peninsula), with the Diomed Islands between,— and the southern point being termed Cape Nome. The bays south and north of it are styled Norton Sound, off Bering Sea, and Kotzebue Sound, off the Arctic Ocean. The northernmost point of Alaska is Point Barrow, where Franklin's second Arctic expedition ended its course. St. Lawrence Island, about 150 m. long, lies between Cape Romanoff and the Siberian peninsula, but nearer the latter; and the Pribyloff Islands of seal fame are out in Bering Sea, about 250 m. northwest of the point of Aliaska.

Alaska compared with the rest of the United States.

Physically the Territory may be divided into four sections, climatically and productively distinct: the Coast-Mountain, the Insular, the Basin, and the Yukon-Arctic Districts.

1. The Coast-Mountain District.— Apart from the islands this consists entirely of two great mountain ranges, geologically distinct, with a gIaciered plateau between them. One (the St. Elias Range) starts at Cross Sound where the coast from northwest turns west, and hugs it closely to Prince William Sound. The other (the Coast Range) comes from the United States and Canada, and runs parallel to the coast till it turns, with a narrow table along the sea; continues northwest behind the St. Elias to about 63° N. lat., forming the western watershed of the upper Yukon; then turns southwest in a stupendous range called the Alaskan Mountains of the Kenai and Aliaskan peninsulas, forming the watershed of the Tananâ and Kuskokwim valleys. The coast range proper is a series of irregular spurs with peaks 6,000 to 8,000 ft. high, the permanent snow line being at an elevation of about 2,000 ft. The Alaskan Range is the highest elevation in North America: flanked on the east by the grand isolated volcano Mt. Wrangell (eruptive early in the 19th century), then from lower summits rising steadily to the west till it culminates in enormous nameless peaks, crowned by a named one, Mt. McKinley, 20,460 ft., the summit of the continent. Of the other peaks in this range, measurements have been taken of Hayes, 14,500 ft.; Sanford, 14,000; Tillman and Drum, 13,300 each; Iliamna and Redoubt, volcanoes, about 12,000 each; and Lituya, 11,832 ft. The St. Elias Range is far loftier, narrower, and more regular than the Coast Range, and next to the Alaskan the highest land on the continent. The part beyond Yakutat Bay is known as the Chugach. Mt. Crillon, near Cross Sound, is 15,900 ft. high; Mt. Fairweather just north, 15,292; Mt. Vancouver, above Yakutat Bay, 15,666; Mt. Cook, above Malaspina Glacier, 13,758; Mt. St. Elias (q.v.), 18,024. The highest peak of this range, Mt. Logan, back of Mt. Cook (19,500 ft.), is in Canada.

The seaward flanks of all these mountains bear in most places fields of everlasting and ever-fresh ice, from which move down to the coast through the valleys the rivers of ice called glaciers; but the St. Elias has scarce anything else, the Chugach producing the most enormous ones on earth outside the polar regions. The Swiss glaciers beside them would be nameless and disregarded rills. These ice-rivers have plowed their valleys into deep gorges, sinking for miles inland far below sea-level and creating the fiords or narrow steep-walled mountain bays with which the coast is fringed, and making islands of the lower coastal lands. Every gorge down to the head of its fiord is choked with these ice-streams, pushing swiftly down and breaking off hourly in an amazing number of gigantic icebergs; and where there is a strip of coast between the mountain-foot and the sea, they bank up and spread out over it in titanic ice walls of many miles frontage. The tremendous Malaspina Glacier, which lies along Yakutat Bay and the coast beyond, is the most notable of these: it is 1,550 ft. high, and has an area of 500 to 600 sq. m. Valdez Glacier at Prince William Sound runs 15 m. along the coast, full of death-dealing crevices. The most familiar are those along the Klondike route: Muir Glacier at the head and east end of Glacier Bay, over 200 feet high and 3 m. long, and Pacific Glacier to the west of it, off Fairweather Mountain. Other vast ones are Miles Glacier off the mouth of Copper River, and Baring Glacier just east of it.

Real rivers are naturally few in this district. The little Chilkat running into Lynn Canal is familiar from the pass above it. The largest is the Copper River, with a considerable affluent, the Chechitna, both unnavigable from rapids. Nearly as large and more valuable is the Sushitna flowing into Cook's Inlet, navigable for 110 m.; its affluent, the Yentna, is navigable for 100 more, and leads to a pass into the Kuskokwim Valley. The Knik empties into a fiord of Cook's inlet, and has an arm, the Matanuska.

2. The Insular District comprises the Aliaskan Peninsula and the Aleutian Islands, the southwestern continuation of the Alaskan chain nearly to Siberia; the lower levels sinking under the ocean, and for over 1,000 miles only the tops showing as islands, though these sometimes rise thousands of feet about the waves. Of the 150 composing the chain 61 are volcanoes, of which 10 are sporadically active; the monarch of all is the grand Shishaldin, 8,000 ft. above the sea. Akuten, Mashunin, and others, are also on fire. Bogoslov was thrown up by volcanic action in 1796. They have grass and shrubs, but no trees. The great wooded Kadiak Island, just east and near the mainland, is a prolongation of Kenai Peninsula and belongs to the first group.

3. The Basin District.— This is the great space enclosed by the Alaskan Mountains southeast and the Lower Yukon watershed (a rather low one), and drained into Bering Sea by the Kuskokwim, a large but shallow and bar-obstructed stream rising on Mt. McKinley. Its somewhat sheltered position gives it a climate possible for civilized existence and available for pasturage and some hardy crops in the lower valley, while the upper valley leads through rich mineral lodes.

4. The Yukon-Arctic District.— The Yukon River (q.v.), one of the chief in the world, emerging from Canada, runs for a long distance in a mountainous plateau; as do its tributaries, the Porcupine, which enters from the northeast at what was Fort Yukon north of the Arctic Circle; Birch Creek, from the southeast not far below, through a now famous mining district; and the Tananâ, rising near Mt. Wrangell, flowing along the eastern and northern flanks of the Alaskan Range, and entering the Yukon about 152° W. lon. In its lower course the Yukon cuts through a vast swampy moor. The coast to the north is mountainous to Point Barrow, including the great central western peninsula; the interior west of the Porcupine Hills continues the moor, sloping to the interminable wastes of tundra (a treeless plain full of ponds and swamps cut up by small valleys) that stretch to the Arctic Ocean. The coast north of the delta is mountainous. Kotzebue Sound receives three large rivers, the Selawik, Kowak, and Noatak; and into the Arctic Ocean on the northern side flows the Colville through vast tundra wastes.

Climate.— The climate of the entire Coast-Mountain and Insular districts is dominated by the two influences of the mountain barrier and the Japanese «Black Current» or Kuro Shiwo (q.v.), which flows along it to California. The former shields the coast from the Arctic winds;

A DOG TRAIN IN ALASKA.

Dog train used in carrying furs from distant inland points. These dogs are half wolf and are remarkably powerful. They can endure the severest cold and wilt quickly in an average summer day of a temperate climate.

the latter fills the air with warm vapors which the prevailing western winds drive against the icy mountain flank, condensing them into almost perpetual rain or fog. The annual rainfall of the southern strip is from 60 to 90 inches (a fall of 156 inches has been known); and the days of rain in the year average from 190 to 285. August and September are specially rainy months. For the same reasons the temperature is less extreme than in districts east of the Rocky Mountains; up to Sitka it is about the same as that of British Columbia. It rarely exceeds 0° or 80°, and is isothermal at 40° annual mean with the lower St. Lawrence, the Rocky Mountains deflecting the line northward. Going north and west there is greater cold, snow and wind; Cook's Inlet, however, is for some reason free from fog. Along the coast of Norton Sound, where the mountainous coast and the warm current flowing into Bering Sea still exercise a tempering influence, the weather remains milder than in the interior, with winters less long and rigorous. But inside the mountains, where their shelter, the moderating current, and the vapors, are all absent, semi-arctic conditions prevail. In the Kuskokwim Valley the average temperature from December to March is about zero, and on the Lower Yukon at Nulato (about 65° N. lat.) it is about — 16°. The Yukon freezes to a depth of from 6 to 9 feet. There is a short warm summer and a very long intense winter in all this district,— the former uncertain, the latter sure; the cold sinks to — 50° in spells. Farther north the climate is pure Arctic: at Point Barrow (where the government keeps up at times a whalers' relief house and a weather observatory) the annual mean is 25°; and the northern tundra has a permanent layer of frozen soil 6 or 8 feet thick from about 3 feet below the surface.

Flora.— The moisture and temperate climate of the southern strip has bred the same gigantic forests which cover the entire northern Pacific coast from northern California upward; their great size and commercial value ending at Cross Sound, and they change to quasi-arctic conditions, but reaching in lesser proportions to Kadiak Island. The deciduous trees are rather small, except the poplars, which are often of great size; but enormous evergreens clothe all the mountains to the snow line and cover all the islands. The many thousands of square miles of white pines, cedars, and firs will soon become of prime importance to a world wasting its trees so fast. Most valuable of all as timber is the yellow cedar (*Cupressus nutkaensis*), a straight-grained and highly durable wood, from which the Haida Indians make their remarkable dugout canoes, sometimes 75 feet long by 8 to 10 wide, and carrying 100 people. The balsam fir is used for tanning. But the local wood-of-all-work is the Sitka or Alaska spruce (*Abies sitchensis*), the most universal of Alaskan trees, reaching in stunted form to the Arctic Circle, but large enough for much utility only on the southeastern and southwestern coasts. It is too knotty for fine boards; but for rough lumber, house or mining timber, firewood and lightwood, sledges, etc., it is the great resource of natives and foreigners alike. The Aleutian Islands have only berry bushes and dwarf willows. The hills of the lower Kuskokwim have little wood; but the mountains of its earlier course have heavy spruce forests on their sides, and the valleys are thick with shrubs, grass, and tall flowering herbs. The northwestern hills are naked. The Yukon-Arctic tundra has only in permanence low bushes and dwarf scrub spruce and willows, though the brief summer brings out a profusion of herbage.

Fauna.— That of Alaska is of immense variety and commercial importance. The fur animals are of course first in popular interest. Most valued is the sea-otter (*Latax lutris*) of the southern coast, once plentiful and the means of livelihood of many Aleut trappers; but for that reason it is now nearly exterminated, only 154 being caught in 1889. The marten, the wolverene, and the coarser-furred ermine are common; sables are found in the forests; and mink, muskrat, and some though diminishing otter and beaver in the rivers. Foxes are of several kinds and among the most valuable of fur animals; the white arctic fox is found on the western coast and the northern islands; the blue fox on the Aleutians, where it is regularly bred for its fur; red and cross foxes in all parts; the black fox in the eastern mountains. Bears (q.v.) include the grizzly, black, polar, and glacier, and the gigantic Kadiak varieties. Gray wolves, the ancestors of the sledge dog, furnish a coarse fur, and lynxes and smaller animals, finer varieties. Fossil-elephant ivory is an article of commerce. The food animals include the moose of the Kuskokwim Valley; the caribou-reindeer, once numerous, but now nearly exterminated, though the government is attempting to stock the country with Lapland and Siberian reindeer; the arctic hare and porcupine, marmots, squirrels, and lemmings; with sheep and goats in the southeastern mountains. The list of birds and mammals of purely scientific interest is very great, but cannot be given here. Swarms of insects are as numerous and formidable as in the tropics; especially mosquitoes, which rise in throngs to the very shores of the Arctic Ocean, sting even bears and moose around the eyes till they are maddened into miring themselves in the swamps, force the native hunter to wrap his head in furs, and make a settled lowland class almost an impossibility.

Seals, Whales, etc.— The fur seal once swarmed all along the western coast and the Bering Sea islands, but now resorts solely to the Pribyloff and Copper islands. The former were leased many years ago to the Alaska Commercial Company, under contract to kill only 100,000 adult males a year, no females or very young males. As the herds showed signs of exhaustion, the number was reduced to 30,000; but the company is now able to secure little more than half that number, as pelagic sealing — before the herds reach the islands — is rapidly annihilating them. Forbidden by the United States to its subjects, this pelagic sealing was done by Canadians (some, perhaps, with American capital behind them), who killed many more at sea than the company does on the islands, and without restriction of kind. The United States tried for years to have Great Britain join in suppressing the slaughter; but that country would not antagonize Canada to the behoof of the United States (though to its own also, as the seals furnish the most important fur of the world). At last, in 1902, Great Britain formed a protective agreement with the

United States; on which the Canadians took shelter under the Japanese flag and went on slaughtering as before. Unless all the great Powers join hands, the practical extinction of the fur-seal is predictable in no long time, with the destruction of the livelihood of many native Alaskans. The other seals, though of no moment to civilized trade, are the very life of the natives, who shoot and spear them for food, dress, boots, tents, boats, dog harness, whips, etc., and use the skins in barter. The walrus fills a similar function to the Eskimo around and north of Bering Strait; but its hunting by civilized men for ivory is also exterminating the race. The natives also rely much on whales, which are likewise hunted by the whaling fleets, which take about 150 a year, and often linger too long and are frozen in for the winter; thus arctic conditions render the extinction of the whale unlikely.

For *Fisheries, Agriculture, Commerce and Transportation*, etc., see ALASKA, RECENT DEVELOPMENT OF. See also FUR TRADE, THE.

Geology.— Alaska is geologically one of the latest portions of the continent. The west coast and the Aleutian Islands are of very recent volcanic upthrow; and the entire peninsula islands and Bering Sea basin are still rising. The activity of the forces now at work is shown not only by the vast number of volcanoes eruptive or but recently so, but by the great number of valuable hot mineral springs of every chemical character. The southeastern strip and archipelago are believed to be later than the Triassic period; they are part of the Rocky Mountain granitic system, overlaid by sedimentary rocks. The St. Elias is thought to be the youngest range on the continent, and post-Tertiary in elevation.

Minerals.— Coal is found in many places, from the upper Yukon to the Aleutian Islands and Cape Lisburne, where it is now and then utilized by whalers or revenue vessels. Much money has been sunk in mining it: but it is a sulphurous lignite, endurable only for household use, and it has been found cheaper to import coal for making steam. The iron is also poor. Copper, galena, marbles, and petroleum are other products as yet not much exploited.

The all-important mineral product so far is gold, in which Alaska promises to take high rank. The Russians and trappers knew of gold sands and placers, but the Russian government did not wish prospecting in a district utterly beyond effective control. With its acquisition by the United States a new policy prevailed, and prospectors began an active search for precious metals. The first great discovery was made on Douglas Island, in the Alexander Archipelago at the foot of Lynn Canal: the first placer, which drew together a mining-camp; then of the quartz ledges they had crumbled from, which in the hands of a powerful corporation rank among the richest mines of the world, keeping 1,500 stamps busy, and making the island and adjoining mainland one huge mine, connected by a tunnel under the water. Exhaustless water-power close by, and the ore cars running down to the stamps by their own weight, enable very low-grade ores to be worked at a high margin of profit. Profitable mines have also been opened near by, and the town of Juneau is built up by this interest on the mainland shore opposite. Other mines are worked in various islands of the Archipelago and along the shores, some around Sitka, some on Lynn Canal. Placer mining and sand-washing have also yielded a good return at Yakutat Bay and on the islands and shores about Cook's Inlet. Greater still were the discoveries in the Yukon basin, instigated by the Klondike placer finds higher up the river on Canadian soil in 1896–7. The whole upper Yukon was eagerly prospected, and very rich deposits found, especially in the valleys of the affluents Tananâ and Birch Creek, which produced about $1,000,000 in 1900. But greatest of all was the result of washing the beach sands on Norton Sound; those at Cape Nome were found in 1898–9 to be so rich that the neighboring streams which fed them were searched, and some of the richest placers on the earth revealed. The return of the washing was fully $4,000,000 in 1900. The whole Territory produced $8,171,000, or 395,039 ounces of fine gold, against 121,766 ounces valued at $2,459,500 in 1899, or 3⅓ times increase in one year.

Population.— Rough estimates were made by Russians in 1839 and 1863, with results of 39,813 and 30,434 — the latter certainly the more nearly accurate. In 1880 the first United States census was attempted under many difficulties, and found 430 whites, 1,756 half-breeds, and 31,240 natives — 33,426 in all. In 1890 a closer computation fixed the total at 32,052 of all kinds. In 1900 it was returned at 63,592: native Indian, 29,536; Chinese, 3,116; Japanese, 279; negro, 168; white, 30,493, of whom only 3,200 were female. The Chinese were mostly in the southern salmon canneries and lumbering industries. Of the increase of 31,540 over 1890, pretty much all white, 23,435 was in the Yukon basin. Making allowance for errors in former calculations, the natives had fallen off somewhat. In the past two years more than 25,000 men are estimated to have poured into the Nome district, making perhaps 90,000 altogether, about 60,000 being white.

The native races of Alaska are from four main stocks: (1) The Eskimo (q.v.), occupying originally most of the interior and coasts. (2) The Athabascans (q.v.), who occupied the upper Yukon Valley and Eastern mountains, and the southern coast from Yakutat Bay to Cook's Inlet. (3) The Aleuts (see ALEUTIAN ISLANDS), of the Aliaskan Peninsula and the islands beyond. (4) The Thlinkeets (q.v.), from Yakutat Bay to Puget Sound, a superior race. The Alaskans as a body are of a far higher type than the Red Indians — a fact which makes the theory of the peopling of America from Siberia improbable. They have not needed to be put in reservations, as they have not the fickleness or ferocity of the Red Indians, have a far better forecast of the future and greater willingness to labor steadily, and have readily taken up civilized individual employments. There is no industry brought in by white men in which natives cannot be employed, though they are debarred from several by the refusal to admit them to citizenship. Unfortunately the rapid killing off of the land and marine animals and river fish by white companies is impairing their old livelihoods, and liquor and alien diseases are decimating them; the Aleuts are nearly exterminated.

Painted by Charles R. Knight.

THE KADIAK FOX.

THE KADIAK BEAR.

ALASKAN MAMMALS DISCOVERED BY THE HARRIMAN EXPEDITION, ALASKA.

COURTESY OF DOUBLEDAY, PAGE & CO. Photographed by Miles Bros.

1. City of Skagway. 2. City of Dawson.

Government.— Alaska, like other Territories, is governed by United States officials: there is a governor resident at Sitka, a surveyor-general, courts and judges, etc. There is no Territorial legislature, however; but municipal self-government is allowed to towns of some size. It is divided into three judicial districts, with headquarters at Juneau, Eagle City, and St. Michael; the judges may appoint commissioners in their districts to act as civil and criminal officers, recorders, judges of probate, etc. A criminal code was given it in 1899, a civil code in 1900.

Education and Religion.— In 1900 the United States appropriated $30,000 for public schools in Alaska, and maintained 25. Towns may tax themselves for school purposes. Mission schools are maintained by various Protestant bodies (who are active in Christian work here), and the Russian Greek Church, which also sustains churches. An industrial training-school at Sitka is supported by the Presbyterian Church. The majority of the natives are Christianized.

History.— The peninsula and strait were discovered in 1728 by Vitus Bering, a Danish navigator in Russian service. He explored the coast and islands in 1741, and Russian adventurers entered the country, maltreating the natives so that they once provoked a massacre which was frightfully avenged. Capt. Cook explored the coast in 1776, discovering Cook's Inlet. The same year the Russians organized a company for the Alaska trade, and in 1784 made the first permanent settlement at Three Saints, on Kadiak Island. In 1790 they made the famous Alexander Baranov manager. He established a colony on Bering Strait in 1796; in 1799, when the Russian-American Company was organized, with a 20-year monopoly, extended in 1820 and 1844, Baranov, as their manager, took possession of the island named after him, founded Sitka, and began an extensive trade with the natives which was afterward extended to China and the Atlantic ports of the United States. Under its auspices the Russian Greek Church established many missions. A scheme to lay a cable under Bering Strait, for which energetic explorations were carried on 1864–7, was superseded by the Atlantic cable. But the territory never paid its expenses to Russia, which was saddled with claims on its behoof and was anxious to be rid of it. During the Civil War she was actively friendly to the United States government, putting warships at its disposal; and as a disguised payment the government, on the advice of William H. Seward, secretary of state,— who had an enthusiastic belief in Alaska's future,— took the territory off her hands in March 1867, paying $7,200,000 for it. On 18 October the American forces took formal possession at Sitka, and the next year the United States customs, etc., laws were extended over it. The United States and Russia claimed joint ownership of Bering Sea as an inland water, to protect their seal-fisheries; Great Britain could not be expected to allow the claim for so vast an oceanic body, especially when urged by Canadian sealing interests, and the seizure of Canadian sealing vessels by the United States caused an acrid international dispute for years. At length in 1902 a protective agreement was entered into between the two nations; for its results see *Seals, etc.*, above. There was also an old contention as to United States and Canadian boundaries, not pressed because the districts in debate were reckoned worthless. But the gold discoveries on the Yukon in 1896–7 and at Cape Nome in 1898–9 (see *Minerals* and *Chief Towns*, above), with the vast influx of population, made some settlement imperative; for years no decision was arrived at beyond a *modus vivendi*, the rival claims covering too much of value, but on 3 Sept. 1903 the ALASKAN BOUNDARY COMMISSION (q.v.) met in London to determine the matter. The chief crux was over the district around Lynn Canal, Canada claiming the ports at the head which form part of the main Klondike routes,— Skagway, Dyea, and Pyramid Harbor.

Although it is of evident importance that the United States navy should in case of a crisis be able to obtain coal supplies at Sitka, no coal is kept there by mercantile companies, and the navy has frequently been embarrassed for want of such supplies in the protection of American seal and other interests. In May 1903 preliminary steps were taken for the establishment of a coal station at Dutch Harbor. This port is in the northern part of Unalaska (q.v.), one of the Aleutian Islands, and is on the direct commercial routes between the ports of Bering Sea and southern Alaska and the Pacific coast of the United States. It is also on the line of steamers passing through the Unimak Pass, most of which make it a port of call. Dutch Harbor will form the fifth station in the chain of coal depots along the Pacific Coast, which will begin at San Diego and include San Francisco, Puget Sound, and Sitka. The fact that Alaska is separated from the States by hundreds of miles of coast line in a foreign domain, constitutes a strong reason why that great territory should be provided with its own coaling stations. Territorial status was granted to Alaska 6 June 1900.

Bibliography.— Abercrombie (W. R.), 'Alaska' (1899); Aldrich (H. L.), 'Arctic Alaska and Siberia'; Balch, 'The Alaska-Canadian Frontier' (1902); Bancroft (H. H.), 'Alaska, 1730–1885'; Bruce, 'Alaska: Its History and Resources'; 'Compilation of Narratives of Explorations in Alaska' (U. S. Military Affairs Committee); Elliott, 'Our Arctic Province'; Foster (J. W.), 'The Alaskan Boundary'; Harriman, 'Alaska Expedition'; Jackson (Sheldon), 'Alaska'; Karr, 'The Shores and Alps of Alaska'; 'Maps and Descriptions of Routes of Exploration in Alaska in 1898' (U. S. Geological Survey); 'Monograph on Seal Islands' (10th U. S. Census Report); Petroff, 'Population and Resources of Alaska' (11th U. S. Census Report); Reid, 'Studies of the Muir Glacier'; Report of Commissioner of Education (1901); Russell, 'An Expedition to Mount St. Elias' (U. S. Geological Survey); Schwatka, 'Report of a Military Reconnaissance in Alaska' (1883); 'Along Alaska's Great River'; Swan, 'The Northwest Coast' (U. S. Geological Survey); Swineford, 'Alaska'; Vancouver, 'Voyage of Discovery to the North Pacific Ocean in 1790–5'; Whymper, 'Travel and Adventure in Alaska'; Wright, 'The Ice Age in North America.'

Alaska, Commercial. The United States purchased Alaska from Russia, in 1867, for $7,200,000. Prior to the purchase and for some years, chiefly after the discovery of gold in Cal-

ifornia in 1849, a considerable trade in fish, lumber, and ice, had been built up between San Francisco and Alaska. On that point, the Hon. O. P. Austin, chief of the Bureau of Statistics of the Department of Commerce and Labor, in his monograph on Alaska, published in 1903, says: "Commercial companies were formed in San Francisco and Alaska to engage in that trade, and the information thus obtained regarding Alaska and its possibilities, formed some of the causes which led to the favorable consideration of the proffer of sale of Alaska, made by the Russian ambassador at Washington to Secretary of State Seward, in 1864, and completed in 1867." Thus was the vast territory of Alaska and the Aleutian Islands acquired and added to the national domain of the United States for what is now the value of the country's internal commerce, for only one hour, reckoning that commerce at twenty-two thousand million dollars a year, the working days at three hundred yearly, and the working hours at ten for each day.

Great progress in Alaskan matters generally, and in its value to the United States has been made since the day on which "Seward's Iceberg" was acquired, but even yet only the fringe of Alaskan possibilities has been touched. With the acquirement of Hawaii, Guam and the Philippine Islands, undreamed of in Seward's day and until a very few years ago, with the farthest point of the Aleutian Islands almost touching the farthest point of the Empire of Japan, with the Philippines within as easy reach of Japan as New York is of Liverpool, and with the prolific territory of Hawaii and Little Guam as milestones on the American way across the great Pacific, who can measure the present commercial possibilities of Alaska, with its wealth of furs, fish, gold, coal, iron, and other minerals? Those possibilities cannot be measured, but a brief study of what has been done and is being done, will afford us a glimpse of what the womb of the future has in store for the Alaskan interests of the United States.

Area and Population.— According to the census of 1900 the gross area of Alaska is 590,804 square miles. In a recent report the governor of Alaska states that this is equal to the area of the 20 States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, and Tennessee. In his report for 1901, the governor states that the area of Alaska in acres is 369,529,600.

The journey from Seattle to the nearest point in Alaska covers no greater distance than a journey from New York to Cincinnati, and from Seattle to the most distant point in Alaska is about as far as from New York to San Francisco. The first is a two-day trip by steamer, and the latter (Seattle to Nome) requires 12 days. From Seattle to the gold fields of the Yukon, by ocean steamer, rail and well-equipped river steamer, consumes about six days.

The population of Alaska at the date of the transfer was estimated at about 30,000. One third of this number was Eskimo, located in the entire north, one third Indian, located in the south, and the last one third Russian or mixed Russian and Indian. The census of 1900 gives the population at 63,592, an increase of over 100 per cent. Of the 63,592, 30,507 were whites, 29,536 natives, 3,116 Chinese, 265 Japanese and 158 negroes. Of the 30,507 whites, 27,307 were males. It is not estimated that the population is much greater now (1905) as the Cape Nome and Yukon gold rushes have quieted down.

Industries.— Furs, fisheries, and mining (mainly gold) are the principal industries of Alaska at the present time. From the acquirement of the Territory in 1867 to 1904, inclusive, 37 years, the gross product of these industries has been: Furs, $54,000,000; fisheries, $75,000,000; mining (since 1880), $62,000,000; total, $191,000,000, or more than 26 times the $7,200,000 purchase price of the entire Territory.

Mining.— The recorded gold production began with $6,000 in 1880, reaching $9,101,000 in 1904, by the following quinquennial stages: 1880, $6,000; 1885, $300,000; 1890, $762,500; 1895, $1,615,300; 1900, $8,171,000; 1902, $8,345,000; 1904, $9,101,000.

The silver production has been small: 1890, $9,697; 1895, $86,880; 1900, $94,772; 1904, estimated, $90,000. While gold is the only mining industry in Alaska, which has so far received particular attention, there are other mineral deposits equally valuable waiting development. Large deposits of coal, some of great commercial value, exist in the Copper River Valley, and on the shores of Cook's Inlet. Valuable deposits of iron are believed to exist alongside these coal beds, while extensive copper deposits have been found in the main range of the Coast Mountains. In the Copper River extensive argentiferous quartz deposits of a promising character, have been discovered. From other regions have come rumors of mineral deposits. Putting aside these rumors and the present large annual gold production, it is easy to anticipate how very much greater will be the value of "Commercial Alaska" as soon as railways are built to open these large deposits of coal, iron, and copper, the three mineral resources, the most useful to the gigantic manufacturing interests of the American mainland.

In an address to the American Institute of Mining Engineers, at the Lake Superior meeting in September 1904, Mr. Alfred H. Brooks said: "The developments of the last five years have shown that Alaska, as a field for mining, stands in the first rank among the possessions of the United States. Its annual gold output is now about $8,000,000. It also produces silver, copper and coal in paying quantities, and its recently discovered tin and petroleum promise to become important products. Concurrent with the gradual development of this wealth, the mining public has ceased to regard the Territory simply as an Arctic province, where a few placer miners struggle with adverse conditions to secure a good stake, or a modest fortune. Of late years there has been a large influx of capital to investigate its mineral resources, but in its area of nearly 600,000 square miles there still remain large uncompleted and little known fields."

Mention must also be made of the finding of asbestos, platinum, gypsum, uranium, lead, zinc, graphite in large quantities, near Nome, and marble. The latter promises to become an important product of Alaska. Large quarries covering 400 acres are located on Prince of Wales Island. Gray marble is also found on

Ham's Island and the contiguous mainland. It is exceptionally hard and stands a test of 10,000 pounds to the square inch. The fact must also be recorded that the principal mines of lignite, anthracite, bituminous and cannel coal, found in every section of the Territory, are located on navigable streams, and near tide water, thus enabling this industry, when railroad transportation is provided, to be placed on a favorable footing as a competitor with the coal fields of British Columbia. The coal mining of Alaska is destined to be an enormous industry. In the Seattle Chamber of Commerce room, there is a lump of coal weighing 1,500 pounds. It came from Cape Sabine, in the Arctic Ocean. Ships have mined their own coal there. In his annual report for 1902, the governor of Alaska said: "One thing about the gold from Alaska that should not be forgotten is that every ounce of it is a measure of human energy and hardship, as much so as is a bushel of grain, a measure of the farmer's toil."

The report of the Senate Committee, sent to Alaska in 1903 to investigate conditions in the Territory, bears ample witness to the vast wealth of Alaska's mineral resources, subject to the provision of transportation facilities, particularly, for all minerals outside of gold, the present annual output of which is more than paying the full purchase price of the Territory each year. Incidentally, the report says: "The resources of Alaska are indicated by the fact that since the government yielded in revenues to the general government nearly $10,000,000, a sum greater by nearly $1,000,000 than the entire expenditure made in her behalf, as appears from the records of the Federal Treasury Department." In other words, Alaska is not costing the Federal government a single dollar to govern the Territory but is actually making a profit for the treasury besides paying its purchase price once each year in gold, and over a million dollars more, to say nothing of the nearly $10,000,000 a year which it sends us in furs and fish. All the Territory and all its resources to the good, without cost, and a large yearly profit earned, besides. On such a record as that, "Commercial Alaska" has a great present and the certain promise of a far greater future.

With three or four railroads crossing Alaska in different directions, men, capital, and machinery will go in and the coal, iron, copper, lead, zinc, marble, tin, and other minerals will come out, besides a far larger annual output of fish, gold, and silver. Then will go in American products and American manufactures to an amount many millions greater than the $11,108,004 worth of merchandise which we sent to Alaska in 1904.

Agriculture.— Until quite recent years, agriculture was an unknown quantity in connection with Alaska. Furs, fish, and gold absorbed the attention of employers and settlers. But since the United States Department of Agriculture sent representatives into the Territory to examine and seriously consider its agricultural possibilities public attention has been drawn to that class of Alaska's manifold resources. In this neglect to examine into the agricultural possibilities of Alaska, we have one of the many ways in which Alaska, until very late years, has not been taken seriously by the American people. Alaska is a land of more than furs, fish, and gold. It is a land where many phases of agriculture can be profitably utilized.

It is not expected or claimed that Alaska will become a great agricultural territory, but it is capable of supplying the agricultural needs of its present population, and of the population as it gradually increases.

In his report for 1899, the governor of Alaska said: "Oats, wheat, rye, varieties of barley, and buckwheat, cabbage, cauliflower, potatoes, turnips, ruta-bagas, thyme, sage, horseradish, carrots, beets, parsnips, lettuce, radishes, peas, horse-beans, onions, celery, clover, flax, rhubarb, etc., were planted, and nearly every one brought to perfection. The cereals were planted the last of April, and came to maturity with full plump grain the last of September. They grow with rank straw. Good garden truck was successfully grown as far north as Eagle City, upon the Yukon."

In each of his five annual reports since 1899, the governor of Alaska has continued to point out and emphasize the good possibilities of the lines of agriculture, specified above.

In agriculture, Alaska is eminently a poor man's country. Such can get direct and immediate returns for their own labor from adjacent consumers. Farming makes men independent. Farming will give to Alaska a class of thrifty, industrious, and self-reliant citizens — the very class of men who have made the United States what it is to-day, a nation of workers, not idlers; of doers, not dreamers; of men, not chattels.

Agricultural results in Alaska, so far, have been so small, measured in money, that a statistical record or comparison would not mean anything, and is therefore omitted. In this section of American enterprise and energy, Alaska has as yet taken only a few tottering steps. When railroads cross and recross the Territory (and some are already building) agricultural settlers will go in, small farms will be staked off and worked, crops will be raised, local wants supplied, and the surplus be shipped to Oregon, Washington, California, and British Columbia.

Manufactures.— The census of 1900 gives Alaska the following credit for manufacturing interests located in the Territory: Number of establishments, 63; capital, $3,600,409; wage-earners, average, 2,263; wages paid yearly, $1,395,709; cost of materials used yearly, $1,785,776; yearly product, $4,250,984.

We get an idea of the increase in Alaska's interest in manufactures by noting the figures of that interest, as shown by the census of 1890: Number of establishments, 10; capital, $105,727; wage-earners, average, 78; yearly wages, $18,625; cost of materials used, yearly, $30,198; yearly product, $58,440.

The increase here shown, in only ten years, is very large, being practically an increase of 98½ per cent in the yearly product. Among the 2,263 wage-earners only one woman was employed. The other 2,262 were males of at least 16 years of age.

The census of 1900 gives 1,962 as the horse-power in use in Alaskan factories — an increase of 1,511 horse-power or 335 per cent over 1890. This power was furnished by 49 steam engines, 14 water wheels, and 11 electric motors.

Food and kindred products, such as fish, canning and preserving, etc., represented $3,821,136 of the $4,250,984 total yearly product of all the

manufacturing of the Territory, which ranks fourth among the States and Territories of the Union in fish, canning and preserving.

In lumber, manufactured and unmanufactured, the census of 1900 credits Alaska with a yearly product of $429,848. Those two items make up the $4,250,984 total yearly manufacturing product of 1900.

But that is only a beginning. When Alaska has railroads, saw-mills will be built, and its vast forest wealth made use of. Mr. Petroff, an authority, says: *Forests of Alaska:* "The timber of Alaska extends over a much larger area than a great many surmise. It clothes the steep hills and mountain sides, and chokes up the valley of the Alexander Archipelago, and the contiguous mainland; it stretches, less dense, but still abundant, along that inhospitable reach of territory which extends from the head of Cross Sound to the Kenai Peninsula." The "Sitka spruce" is the universal forest tree of Alaska and is found of gigantic size on the islands of the Alexander Archipelago, and on the shores of Prince William Sound. This spruce is used in the construction of nearly every dwelling throughout the Territory. Its sappy outer portion is used as torches to light up the dark dwellings of the interior tribes, and the wood is freely used in many domestic ways. The huge planks for house-building are obtained by splitting, mostly by hand.

One of the most valuable Alaskan woods is yellow cedar. It combines, says Mr. Petroff, a fine close texture, with great hardness, durability, and a peculiar but pleasant odor. The Russians named it "dushnik" (scented wood). During the wasteful Russian occupation of Alaska, this tree, though of such great value, was nearly exterminated in the vicinity of Sitka, and on the Baranof and adjoining islands, but considerable bodies of it still exist on the British Columbian frontier on Prince of Wales Island, on Koo Island, and a few other islands of the Alexander Archipelago. In the Nass and Skeena River valleys it is also abundant.

Other Alaskan woods are hemlock and balsam fir, but not of great value, as compared with the Sitka spruce and the yellow cedar. At present lumber from Puget Sound and British Columbian mills is shipped to nearly all ports in western Alaska for the use of whites and half-breeds, while the natives in their more remote settlements obtain planks and boards by the very laborious process of splitting logs with iron or ivory wedges. Evidently the forests of Alaska have a large commercial value, which railroads will turn into money. In the meantime, we have it as a resource, against the day when the timber of Oregon and Washington becomes scarce.

Fisheries.— The fisheries of Alaska more than pay the entire $7,200,000 original cost of the Territory each year. They are of greater annual value than the annual gold field, though that also, each year, produces more than what the Territory cost. Quoting the Hon. O. P. Austin, chief of the Bureau of Statistics again, we find that in 1901 the Territory packed and shipped 2,029,269 cases of 48 one-pound cans each, and 18,942 barrels, composing in all 100,-000,000 pounds of salmon, taken from Alaska waters in one year.

To produce this result required 30 companies and individual packers, occupying 55 canneries, and 12 salteries and using 31,000,000 salmon. The capitalization of these enterprises was $22,000,000, and the value of the plants, including vessels, was $12,000,000. All this has grown from two establishments in 1881, producing 13,000 cases a year, of the value of $50,000. The value of the salmon pack in 1901 was $7,075,000. These figures show an increase in the yearly product of 14,000 per cent or 140 fold in the short space of 20 years. The annual packs of salmon since 1901 have been: 1902, $7,834,000; 1903, $8,606,000; 1904, $0.-054,000; while the annual breed of salmon does not lessen, but the contrary. This is a case where we do not have to buy the raw material. It is a nature's free gift to us each year, just as is gold and everything else we get out of the ground. In this reflection we strike the keynote of the marvelous prosperity of the United States — its boundless natural resources. But salmon is not the only fish which Alaska produces. The codfishing industry is also worth $150,000 a year. The area in which the cod may be taken and the supply justify the statement that the cod fisheries of Alaska are destined to exceed in value those of Newfoundland, or any other part of the world. As a safe calculation, there is not less than 125,000 square miles of codfishing in connection with the Alaska coast. Then there are Atka or Attu mackerel, black cod, halibut, and herring. The salmon industry employs about 13,000 persons, including 5,000 Chinamen and 2,500 natives. The yearly pay roll amounts to about $2,700,000. The tin plate used costs $1,150,000. This disbursement of more than a million dollars for tin cans is a noteworthy fact. In 1901, the shipping employed was 110 steamers, 55 sailing vessels, and 1,777 lighters and boats, a very imposing fleet.

The government tax of 4 cents a case and 10 cents a barrel yields about $100,000 a year. The salmon pack of Alaska fills about one half the yearly requirement of the United States. In 1902 the Pacific coast pack was worth $4,259,000. As the two packs combined fill only 75 per cent of the American demand, and as that demand grows with the rapid increase in population, and further, as salmon are heavy breeders, it is evident that the salmon industry of Alaska as well as that of the Pacific coast has a growing future. That part of "Commercial Alaska," as well as the gold part, is an immediate and continuously profitable proposition.

Fur Seals.—The Pribilof Islands are the seat of the fur seals industry of Alaska. They came to us in the purchase from Russia. They are leased to the North American Commercial Company by the United States Government for an annual rental of $60,000 and a tax upon each skin taken of $10.22½. The number of seals to be killed each year being fixed by regulation of the secretary of the treasury. In the years 1870–1902, the lessees have taken 2,209,621 seals.

No official statements of the value of the seal skins taken on the Probilof Islands are made. Mr. Petroff, the agent of the United States Census in 1890, estimated the value of seal skins taken in Alaska from 1867 to 1890, at $31,537,592. This estimate, combined with estimates from official sources since justifies an allowance of $50,000,000 as the value of the seal skins, taken from the purchase of the Territory to the present date. The sea otter and

others bring the total for furs up to $54,000,000.

Education and Churches.— The entire educational work in Alaska, except in the incorporated towns, is under the control of the Rev. Sheldon Jackson, D.D., United States General Agency of Education in the Territory. His report for 1904 shows 35 public schools, 38 teachers, and 2,257 pupils outside of the schools in towns. Nineteen of the new schools were established in 1904. The expenses are $56,211.

The Presbyterian Church supports 14 missions and a hospital and training school. The Protestant Episcopal Church has 10 missions, and the Catholic and other religious organizations a smaller number.

All this is education, and it has a direct bearing on the present and future of Commercial Alaska.

Transportation.— Transportation in Alaska, while not to-day the problem it was a few years ago, is still the "question of the hour" and the fundamental necessity and prime requisite of commercial or other success in the Territory. In the summer there is one boat of 1,000 tons each day for the ocean travel from Puget Sound to Skagway. One can now go by rail from Skagway to White Horse, over the mountains, and freight rates are only one tenth of what they were before the railroad was built. In the summer season the ardent adventurers can go by semi-weekly steamers from White Horse to Dawson. In the winter the trip has to be made by stage. Lodging houses along the road charge about $6 a day for meals and lodging. In the summer the $75 boat fare includes meals. The steamboats on the Yukon River are modern and well equipped. Nome is reached by steamer from Sitka to Unalaska in the Aleutian chain of islands, and thence north to Saint Michael and Nome.

Something is being done for transportation, through sundry small appropriations in the army bill, toward building wagon roads and trails. Says the governor: "Trails are better than nothing. If Congress cannot bring itself to aid us to railroads, then we shall be grateful for wagon roads, and if they are impossible let us have trails; but the railroads are bound to be built. The American spirit animates the movement. Governor Gilpin's dream of a 'cosmopolitan railway' will be realized."

Postal Service.— Just as fast as Alaska needs and can take care of post-offices, they are being started. Daily mails leave the Pacific coast for Alaska. The present number of post-offices is about 80, and mails are regularly delivered north of the Arctic Circle.

Telegraphs.— The United States and the world now has telegraphic communication with all the chief centres of population in Alaska. This work has been done by the signal office of the War Department. The lines also connect with those of the Canadian telegraph system, and with all the telegraph systems of the United States.

A military cable, 1,300 miles long, connects Seattle with Juneau and Sitka, affording an alternate route (the Canadian is the other) for commercial business and a more direct and satisfactory means of telegraphic communication for the government.

Land Laws.— The law recently enacted by Congress permits the application of the homestead laws of the United States to tracts not exceeding 80 acres. Owing to the lack of surveys very few homesteads have yet been applied for under this act. But they will when Alaska has railroads, because railroads involve surveys, and emigration from one point to another always follows the whistle of the locomotive.

Commerce.— The commerce of Alaska is a substantial and growing quantity. Beginning with nothing less than a generation ago, it has already reached satisfactory proportions. It is not necessary to trace at length the history of Alaskan commerce from the acquirement of the Territory, as for quite a number of years after that act of farsighted statesmanship Alaska was only thought of as the place from whence the seal skins of our wives, our daughters, and our sweethearts came. It is a vastly different proposition to-day, with the acquirement of Hawaii and the Philippines, the American Pacific cable in operation, the American Panama Canal in sight, and the Alaskan boundary dispute settled in our favor. Commerce between the United States and Alaska means something these days, and the commerce of Alaska with Canada and the Far East is beginning to tell.

A few figures will tell the story.

	From the U. S.	From Other Countries.	Total.
1879	$ 317,000	$ 4,791	
1890	1,897,000	24,577	
1895	3,017,000	55,080	
1903	9,509,701	477,463	$ 9,987,164
1904	10,165,110	667,355	10,772,465
1905 (est.)	11,000,000	800,000	11,800,000

Alaskan Exports to all Countries.

1879	$50,378
1890	4,682
1895	11,520

	To the U. S.	To Other Countries.	Total.
1903	$10,228,569	$1,612,128	$11,840,697
1904	10,165,140	1,565,690	11,730,830
1905 (est.)	11,000,000	1,700,000	12,700,000

These export figures are exclusive of the Canadian dug gold — about $10,000,000 a year, which reaches the United States through Alaska.

Summary for 1904, actual:

Alaskan imports	$10,772,465
Alaskan exports	11,840,697
Canadian gold	10,000,000
Total commerce	$32,613,162

Summary for 1905, estimated:

Alaskan imports	$11,800,000
Alaskan exports	12,700,000
Canadian gold	10,000,000
Total commerce	$34,500,000

This is the concrete result of 38 years of American "Commercial Alaska." Nothing to begin with, practically nothing for 27 years after the beginning (only $3,000,000 in 1895), then a growth to $30,000,000 more a year in nine years. Almost an average growth of $1,000,000 a year, for each of the 38 years life of American "Commercial Alaska," with 27 of those 38 years practically dormant.

WALTER J. BALLARD.

Alaska, Recent Development of. No longer is Alaska, even in popular conception, the lone land of ice and snows which fiction and tradition long presented it. Northward, swift on the

heels of the gold-seeking pioneers, have gone railroad builders and telegraph linemen, engineers, capitalists, bankers, teachers, and settlers, until not only Alaska but the whole vast stretch of the Far Northwest is repeating California's marvelous story of development. Steamers, many of them palatial in their fittings, now navigate the Alaskan rivers; towns with organized systems of government are growing fast, with schools and banks and churches, and streets lighted by electricity, and paved. The telegraph and the telephone connect the principal settlements, and railroads are being built which in a year or two will traverse the peninsula almost from end to end.

Yet the new Alaska, which has become so important a reality, is, in a measure, but a startling revival of the commercial Alaska of 60 years ago. Then Sitka—a thousand miles north from Seattle Washington — was the industrial capital of the Pacific coast of America, and San Francisco but a gathering place for indolent rancheros, who bought their plowshares, hoes and hatchets from the industrious workmen of the Far North. From the shipyards of Sitka went forth the first steamships built on the Pacific, and the bells which will chime from many a Catholic mission-house were cast there. No better equipped naval station existed than that at the Alaskan capital, nor busier brass and iron foundries and machine-shops. The California "Forty-Niner" worked with a pick and shovel made at Sitka; the woolen-stuff clothing which he wore came from Sitka; the salt fish he ate and the lumber with which he built were also the product of far-away Alaska, carried in Sitkan-built vessels, manned by Sitka sailors.

But the military managers of the Russian-American Company were not captains of industry. Vast sums were squandered in impracticable experiments, in mining valueless coal, in extracting iron from inferior ore, in making bricks and woodenware for which no market existed. Thus the trade of Sitka languished, and in time the catching of fish and furs became the only occupation of the Alaskans. Even the purchase of the country by the United States failed for many years to add a stimulus to its lapsed industry.

The new North which has arisen may not again dominate the trade of the Pacific Coast, but it has attained an intrinsic importance of which the Russian owners of Alaska never dreamed, not merely through its wealth of minerals, its furs, and its fisheries, but also in considerable measure through its possibilities in agriculture. Fields of grain and gardens stocked with every variety of vegetable are now familiar sights on the outskirts of a hundred thriving settlements. From end to end of the Yukon, one of the mighty rivers of the world, the traveler may wander during four months of the year and never see snow. Instead, there will be a tangle of rich vegetation, of great forests, of grass that grows as high as a man's shoulder, and endless fields of beautiful plant life. Wild berries in great variety — raspberries, currants, huckleberries, blackberries, cranberries, etc.— beautiful ferns waving in the soft breezes, great beds of the purple lupine and the red columbine, wild celery and wild parsnip growing many feet high, ponds on which float great yellow lilies, with the purple iris bordering their banks, are everywhere.

When Alaska was purchased by the United States in 1867 its value was lightly regarded. The price paid — $7,000,000 — was thought to be excessive, and there was much popular opposition to the terms. Yet in 36 years the government received in revenues not only the sum expended, but $2,000,000 more. During the same period Alaska and the adjoining Canadian Yukon territory have supplied fish, furs, and mine products amounting in value, at a conservative estimate, to $375,000,000. Goods worth about $40,000,000 a year are now sent in return, and the amount of capital invested there is probably not less than $125,000,000.

Of the future of the new North, President Roosevelt, addressing an audience at Seattle, Washington, in 1903, made this significant prophecy:

"The men of my age who are in this great audience will not be old men before they see one of the greatest and most populous States of the entire Union in Alaska. . . . I predict that Alaska, within the next century, will support as large a population as does the entire Scandinavian peninsula of Europe, the people of which by their brains and energies have left their mark on the face of Europe. I predict that you will see Alaska, with her enormous resources of mineral, her fisheries, and her possibilities that almost exceed belief, produce as hardy and vigorous a race as any part of America."

Not only Alaska, but the entire northwestern portion of the continent — for many hundred miles beyond the international boundary — is undergoing a marvelous development. Ten thousand miles of railroad are already under construction or definitely projected in territory farther north than is now touched by any existing completed line; a greater mileage than that of the Union Pacific, the Northern Pacific, and the Erie systems combined.

A glance at the line in the accompanying map which marks the northern limit of cereal production in America will indicate a reason for this railroad construction. Gold and furs alone could not have brought it about. Were the great western North the bleak counterpart of "pitiless Labrador" the miner and hunter there would still pack their treasures of mineral and fur over weary wastes of snow by dog train. But, whereas in the East the extreme limit of cereal-growing territory is reached in latitude 49°, at a point a little north of Rimouski, on the St. Lawrence River, in the West the limit is Norton Sound, beyond St. Michael's, more than twelve hundred miles nearer the pole. So far north as that are grains now grown.

As long as the States to the south are still undeveloped, the north received but scanty attention. At intervals, it is true, had come reports of great natural wealth which existed there, and now and then the outcropping of a boundary dispute had lent ephemeral interest to the country. But the gold finds of 1896 in the Canadian Yukon and of 1898 near Nome came when the western States were beginning to be filled up. Thousands of American farmers had already moved northward into the Canadian provinces of Manitoba, Assiniboia, and Alberta, beginning a movement which has since assumed enormous proportions. The gold thus hastened a natural development. Prevailing fallacies regarding the climate of the new land disappeared.

In southern Alaska, which is tempered by the warming airs from the Japan current, the thermometer rarely falls to zero, and the changes from midwinter to midsummer do not exceed twenty-five degrees. Even at St. Michael's north of the mouth of the Yukon River, the mean summer temperature is 50° F. In the interior the climate is more severe, but not so bitter as is commonly believed. Daily observations during five summers in the Klondike region show that on the average the temperature there rises to 70° or higher on forty-six days, and to 80° on fourteen days; 90° was recorded in Dawson in June, 1900, and 95° in July of the same year.

Great hardships were undergone by the gold miners during the pioneer period, but these were due to abnormal conditions. The gold fever had carried a great swarm of fortune hunters into an unknown country of vast distances. Confusion, suffering, and even starvation were the natural outcome. An incident in the construction of the White Pass and Yukon Railway well illustrates the conditions which then prevailed. On the morning of one June day in 1899 there were 2,000 men at work along the line of the new road — doctors, lawyers, teachers, and college men, in a motley crowd with Chinese laborers, and rough prospectors who could not write their names. That afternoon came the news of a big discovery of gold near Atlin, and in the evening there were but 600 men in camp. The other 1,400 had plunged into the wilderness, carrying with them the company's picks and shovels, but leaving behind a half week's pay at ten dollars a day. Such was the spirit of recklessness in which the gold-seekers invaded the new country.

Scenes similar to those which marked the rush to the Klondike were repeated at Nome. The latter place is without a natural harbor, and passengers and supplies had to be landed through the surf. In the months of June and July this is accomplished with little difficulty, but later in the season storms prevail, and the landing is then attended with considerable peril. Vessels are forced to anchor from half a mile to two miles from the shallow beach, and their cargoes removed in lighters, which were frequently lost in the surf. Wrecks of schooners, barges, steam-launches, boats, and stern-wheel steamers littered the beach at Nome every year, and pumps, donkey boilers and engines, dredging machinery and damaged provisions were strewn along the shore.

The first discovery of gold at Nome was made by a United States soldier who was digging a well, and the first to profit by it was an old prospector from Idaho, who was ill and not able to reach the gulches farther inland. In twenty days the man from Idaho took out three thousand dollars' worth of gold with a rocker. With the news of the find a wild frenzy to dig in the beach seized people everywhere, and during the height of the excitement nearly two thousand men were burrowing like moles in the sand. Every man at Nome — physician, lawyer, carpenter, clerk, or whatever else his vocation— abandoned his ordinary work and took up the shovel and rocker. The price of labor went up to fifteen dollars a day, but even at that rate working hands were hard to secure. When the army of miners stopped work in the fall the beach for fifteen miles presented a hugh rampart of piled-up sand, giving to the city the appearance of having been fortified against invasion.

Nome is now a city of 25,000 population, and the building of two new railroads, which are under way, and the improvement of the harbors at Port Clarence and at Solomon, will remove the last of the transportation difficulties of its inhabitants. In the past the only means of forwarding freight from the city to interior points not reached by the Yukon River steamers was by men wading in the shallow streams and pushing flat-bottomed boats ahead of them. The cost was about $300 a ton for fifty miles, and from 8 to 15 days were required to make that distance, according to the conditions of the weather.

Nome is the western terminus of the railroad development of northwestern Alaska, whose roads are the farthest north of all in the world, extending almost within the Arctic Circle. The city is about 250 miles southeast of Cape Prince of Wales, the point at which Alaska most nearly approaches Asia, and is reached by steamers from the western coast of the United States by passing through the Aleutian chain, past Unalaska, as well as by rail from Skagway and steamboat down the Yukon River. Nome boasts good hotels, large stores, daily newspapers, banks, electric lights, telegraph and telephone systems, and the other usual adjuncts of civilization in more southern climes. It is connected with St. Michael's by cable, and by telegraph with Dawson and Skagway. Handsome private residences are being built by men who have made their money there and who have settled down to make the city their home. Well-kept lawns and flower gardens add to the wonderful metamorphosis which has overtaken the sandy beach.

Seward Peninsula, on which Nome is situated, is being rapidly "gridironed" by the various railroads built to communicate with the principal gold mines and with the other towns in that part of Alaska. The Valdez Copper River & Yukon Railway will run from Valdez, the most northerly port in Alaska, to Eagle City, a distance of 430 miles, and will open up the mineral and agricultural districts of the Copper, Tananá, and Yukon valleys. Construction has already begun on this line, the route lying through a country which is heavily timbered, with tributary territory rich in gold, copper, and coal. With a railroad projected, as a part of the Grand Trunk Pacific System, from Port Simpson to Dawson, with a 100-mile line soon to be built from Dawson north, and with the Valdez Copper River & Yukon Railway coming east to Eagle City and west to connect with the Nome & Solomon City Railroad, it remains but a question of time when there will be all-rail communication from New York to Norton Sound, a few miles across Bering Strait from the continent of Asia. A northern spur from the Trans-Siberian Railway would then realize the once lightly regarded dream of "New York to Paris by rail."

The first railroad undertaking in the Far North was begun in southern Alaska and the British Yukon in 1898. In June of that year work was begun by a syndicate of English capitalists on what is now the White Pass & Yukon Railway, extending from Skagway, in Alaska, to White Horse, Yukon Territory, a distance of 112 miles. It was constructed pri-

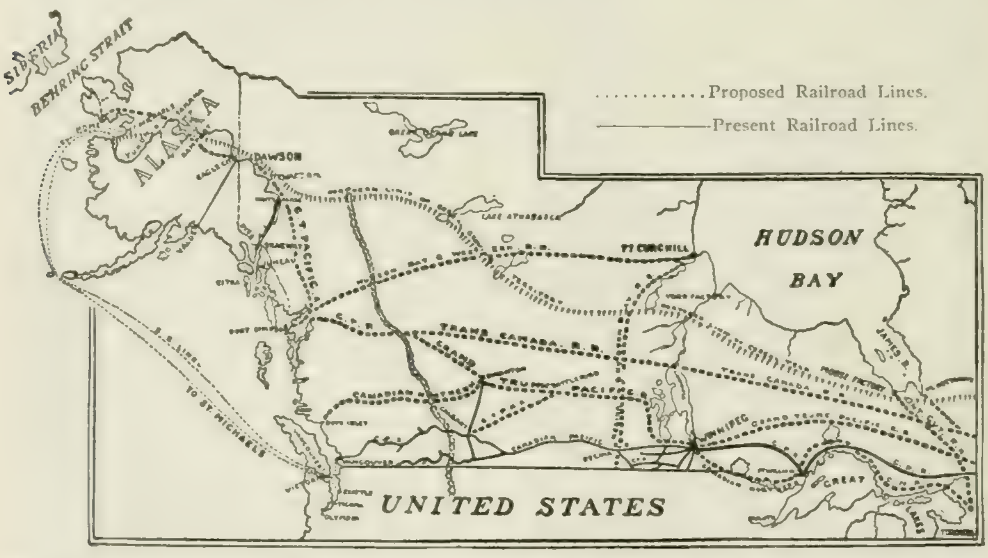
marily to afford access to the gold fields of the Canadian Yukon, but has since been made a link in the continuous rail and river route to northwestern Alaska and Seward Peninsula. The road was completed to White Horse in June, 1900, at places the cost of construction exceeding $250,000 a mile. The route had been used for pack-horses in the fall of 1897, but the trail was almost impassable, and immense numbers of the animals had died in their tracks. Two thousand had to be collected and burned with kerosene before the work could be undertaken. In attempting to lower Lake St. Louis about three feet, the entire lake washed away, causing widespread damage. The total cost of the White Pass Railroad was about $5,000,000; but it paid nearly $2,000,000 profits during its first two years' operations.

From White Horse to Dawson — which has a population of 1,200 — a distance of 482 miles, connection is now made by modern steamers in summer and by four-horse sleighs in winter. The stages used in winter cover the distance, under ordinary conditions of weather, in three and a half days, or at a rate of about 90 miles a day. A railroad was built last summer from West Dawson to Stewart River, a distance of 82 miles, tapping the rich mining districts in that direction. A number of other railroads leading to different gold centres are now being constructed, and in a few years Dawson will be connected with its outlying districts in every direction, and even, it is projected, with the transcontinental lines to the south.

Dawson enjoys almost as many municipal advantages as any place of its size in the United States. It has a splendid system of water-works, a local telephone system and long-distance connections with the principal mines, telegraphic communication with the world, churches of every denomination, large Federal and municipal buildings, and good schools. There are a number of clubs and lodges, as well as theatres and other places of amusement, and three banks. The personal and realty assessment of the city exceeded $11,000,000 last year, and post-office orders to the value of $1,800,500 were sold. The streets are all thoroughly lighted by electricity. Lines of steamboats along the wharves, loading and unloading, and steam dredges at work in the river, give an animated aspect to the water-front. More than $5,000,000 is about to be spent by a private company in installing a huge water-supply and pumping plant to furnish water for consumption and for mining purposes, in working the deposits that line the side-bars of the neighboring streams.

Three years ago the inhabitants of Dawson lived principally on dried and canned meats and German sliced evaporated potatoes. To-day fresh meat is brought in, frozen in winter and in refrigerator cars to White Horse in summer, and all vegetables are grown in market gardens nearby. Nothing pleases the Dawson citizen more than to entertain a skeptical visitor from the south at table with lettuce, asparagus, green peas, or celery, cauliflower, cabbage, and carrots, according to the season, grown in his own rear yard; and the same civic pride has led the Dawson Chamber of Commerce to display some very fine specimens of barley and oats grown in that section. Moreover, throughout the Klondike country live stock can find sufficient feed to sustain life outdoors even in winter.

From Dawson to St. Michael's, by the Yukon River, is 1,600 miles, and during the open season of navigation — from the middle of May till the middle of October — about 40 stern-wheel steamboats run between the two points in from 9 to 12 days. The Yukon is easy to navigate, being without snags and with shores alongside of which boats can run and tie up at almost any desired spot. Between its mouth and the Tananâ it flows with an easy current of about three miles an hour, the stream varying in width from a mile to a mile and a half. The rest of



The great Northwest and its projected transportation facilities, showing also the northern limit of cereal growth.

the river, below Dawson, flows variously through mountainous regions and wide flats, attaining at places a width of 10 miles, with many channels and numerous small islands.

The winter trade begins as soon as the ice has formed in sufficient thickness to sustain teams of dogs and loaded sleighs, and continues until the break-up in the spring. The trail having once been marked by some venturesome first traveler, running as nearly as possible over the smooth ice near the shore, is generally followed thereafter. Although the temperature sometimes falls to 50 degrees below zero, such occasions are rare, and even then the air is dry and uniform and accompanied by little wind. At no part of the route is the traveler out of telegraphic communication with the world.

At Eagle, the first American town beyond Dawson, four large trading companies maintain well-stocked stores, and Fort Egbert, located there, has a garrison of 200 soldiers, with barracks, stables, hospital, and officers' houses. There are two saw-mills, and the town is the headquarters of the United States Weather Service for the interior of Alaska. Several large gardens supply an abundance of vegetables — potatoes, carrots, peas, beans, lettuce, radishes, cauliflower, etc.— and barley and oats are raised in steadily increasing quantities. Grass grows luxuriantly from the fertile soil, and there are large natural meadows in the vicinity from which heavy crops are cut. Mowing machines and other hay-making tools are frequent sights along the bank of the river all the way to St. Michael's.

The railroads of Alaska and of the Canadian Yukon are being built primarily because of the enormous mineral wealth to be tapped. Those projected for the Hudson Bay, North Saskatchewan and Peace River districts have another reason for their inception. Agriculture and lumber are the great natural resources of that vast stretch of little-known territory, and minerals and furs play but subordinate parts.

Almost a thousand miles north of the boundary between the United States and the Canadian Northwest territories, in the valley of the Peace River, wheat, barley, and oats are grown in quantities limited only by the number of agriculturists; and a 100-barrel roller-process flour-mill, the most northerly mill on the continent, has just been completed at Vermilion. Two other water-power stone mills, owned respectively by a private firm and by the Roman Catholic mission, have been running for the past two years, and have been offered more grain than they have been able to handle. Two steam saw-mills are also in continuous operation, while cattle and hogs are raised by the settlers and find a ready market among the traders. The town is lighted by electricity, derived from the water-power of Vermilion Falls.

The wheat which was awarded the first prize at the Centennial Exhibition at Philadelphia in 1876 came from the Peace River country. Farther east, on the south side of Lesser Slave Lake, a wild meadow, 30 to 40 miles in extent, from which three tons of grass to the acre are obtained, gives evidence of the richness of the soil there, while the land on the opposite side is excellently adapted to mixed farming, consisting of open prairie interspersed with tracts of cottonwood timber. Dr. Dawson, of the Canadian Geological Survey, estimates the Peace River country to contain 15,140,000 acres of good arable soil.

The Hudson Bay and Western Railway, the bill incorporating which was passed at the last session of the Canadian Parliament, will connect Port Simpson, on the Pacific, with Fort Churchill, on Hudson Bay, a distance of 1,500 miles, passing through Vermilion and running south of Lake Athabasca and north of Reindeer Lake. Athabasca Lake is connected with Great Slave Lake by the Slave River, and, with the exception of a break about 20 miles long, steamboat navigation between the two is uninterrupted. From Great Slave Lake the Mackenzie River affords a clear course to the Arctic Ocean. For years past steamboats have been plying on the Athabasca and the Mackenzie, and with the Hudson Bay and Western Railway completed it will be possible for a passenger to buy his ticket in New York — or in any other city, for that matter — for the Arctic Ocean, and proceed there with almost as great comfort as if he were booked for the Adirondacks.

Still another railroad — running from North Dakota — will have Fort Churchill as its northeastern terminus. The bill incorporating the construction company was passed by the Canadian Parliament at its last session. Apart from agriculture, the southeastern Hudson Bay district is said to be rich in minerals of all kinds. The fisheries of the bay are also valuable, and whalers from New Bedford even now find it profitable to go there, notwithstanding that it takes them two years to make a catch. Cod, trout, and whitefish in large numbers are found in both Hudson and James Bay. At Moose Factory there are several large gardens, in which all kinds of vegetables and fruits are grown, and cattle find excellent pasturage on the natural meadows, where the wild grass grows in great luxuriance.

The timber wealth of all this section is naturally great, the forests of spruce, pine, and poplar having as yet been scarcely touched by the axe of the woodsman. Unrivaled water-power is furnished by the innumerable streams and rivers, and the transportation of sawn lumber is counted upon to furnish no inconsiderable source of revenue to the railroads. A species of large poplar called "liard," or balm of Gilead, which is much sought for by cabinet-makers, is said to grow very extensively in the Mackenzie Valley, and tamarack for railway construction is found in the entire region. The greater part of the territory, also, is the natural home of pulp-wood, where, it is declared, is a perennial crop to be harvested unsurpassed in the world. The average annual snowfall at Moose Factory, taken for a period of five years, is 80 inches, as compared with 177 inches during the same period at Montreal.

But railroads are only one phase of the increasing activity in the North. The telegraph has far outdistanced the iron horse, and remote corners, as yet long distances removed from any line of railroad, can flash their intelligence around the world. Since 1901 the Signal Corps of the United States Army has put in working order in Alaska more than 1,500 miles of land telegraph lines and submarine cables, and in the Canadian territories of the Yukon and North British Columbia the Dominion Government has

displayed an equal activity. About 2,000 miles of Canadian Government telegraph lines have been built from the international boundary, beyond Dawson, south to Port Simpson and Quesnelle. At the latter point connection is made with the regular commercial lines. Well-equipped telephone services have also been established between the towns, and scarcely a place of 500 inhabitants in the mining country has not its local and long-distance telephone system.

On the Pacific Coast daily mails leave by all the principal steamship lines, and are forwarded from Sitka, Skagway, Nome, and other distributing points by steamer, rail, wagon, and carrier. Where ordinary means of distribution fail, the Russian reindeer, domesticated in Alaska, carry the sacks over the frozen lakes and snow-mantled uplands, traversing a vast distance in an incredibly short time. The highest salaried postal official in the world is in Alaska. He receives $25,000 a year for carrying the mail, twice a month the year around, to Fort Yukon, providing his own dogs and sleds for the purpose. There are now upward of 100 post-offices in Alaska, and mails are delivered regularly beyond the Arctic Circle.

The development of Alaskan oil-fields promises to establish an industry the extent of which cannot be yet foretold. In 1902 an immense oil gusher — Alaska's first — was struck at Cotella, near Kayak, 30 miles south from Copper City. Oil was thrown 150 feet into the air, carrying away everything in its course and being capped with great difficulty. Experts were at once sent to the scene by the officials of the Standard Oil Company, but a Canadian and English syndicate had acted more quickly; and secured control of the larger part of the Kayak fields, comprising 40,000 acres of land which had been leased to the Alaska Development Company. The British capitalists chartered two steamships to convey north from Tacoma, Wash., a great quantity of pipes and machinery obtained from Pittsburg, Pa., together with other supplies. A hundred men were employed in sinking additional wells, and $500,000 was to be spent in development work, including the erection of an experimental refinery.

The fisheries of Alaska are among the richest in the world. Cod, halibut, and other important deep-sea fishes are found in the waters off the coast, and salmon in all the streams. More than half the entire salmon product of the United States comes from Alaskan waters. It is the opinion of competent authorities that the cod banks exceed in wealth those of Newfoundland. The cod industry, however, is as yet only in its infancy — if, indeed, it can be said to have attained even that primitive stage of development. There are about 15,000 persons engaged in the salmon fisheries, and the market value of last season's output was a little more than $7,000,000, which is exactly what we paid for Alaska. The packing industry is conducted at 60 canneries and 15 salteries. The total number of salmon of all varieties taken in 1902 was about 33,000,000. The companies engaged in this industry have a capitalization of about $25,000,000, and their plants, including vessels, are valued at $15,000,000. The amount which they pay in wages exceeds $2,500,000 annually, and the yearly expenditure for tin plate is about $1,100,000. In the shipping of the fisheries last year there were employed 115 steamers, 57 sailing vessels, and 100 boats and lighters. The codfishing firms permanently located in Alaska have vessels, plying only in Alaska, valued at $60,000. According to estimates of the United States Fish Commission, there are not less than 125,000 miles of codfishing along the Alaskan coast.

The special features of Alaska — its furs, fisheries, and gold mines — have been so frequently exploited by writers that an entirely erroneous idea has been conveyed as to the country's other diversified sources of wealth. That a grain-growing soil could be found so far north, with summers sufficiently long to bring wheat to maturity, has not been supposed possible. Yet, as I have already said, not only has wheat been grown and successfully harvested wherever the experiment has been made, but even so far north as Fort Yukon, within the Arctic Circle, oats, rye, and barley are now grown regularly. The winters of Alaska are more hospitable than those of the great plains of Wyoming, Montana, and some parts of Nevada, and in the dead of winter horses and cattle can be worked without fear of being frozen. The temperature frequently is very cold, but there are no storms.

Except on the coast of Bering Sea, all the hardy vegetables are grown with marked success throughout Alaska and the Canadian Yukon south of the Arctic Circle. No finer potatoes, cauliflower, cabbage, kale, peas, lettuce, and radishes could be found anywhere in the United States than samples which I have seen grown at the government experiment stations at Sitka and Kenai, and I have been told by a friend that at Holy Cross Mission he had eaten new potatoes, cauliflower, and other late vegetables in the month of July. At Rampart, in latitude 65°, winter rye, seeded there in August, lived through the winter perfectly, and matured grain by August of the following year. Barley seeded in May was ripe by the middle of August.

The great river valleys of Alaska and the Canadian North embrace cultivable areas large enough to form several good-sized States. All through the interior, in fact, there are to be found extensive tracts of grass lands, the growths from which, could there be found a market for them, would exceed in value the products of all the gold mines. Along the route surveyed for the Valdez Copper River & Yukon Railway, from Valdez to Eagle City, many large meadows, on which the grass was waving waist high, were traversed by the party of engineers. A number of horses were seen which had run at large in this region for two years.

Stock-raising is becoming an important Alaskan industry — within a very few years it is probable that regular shipments of cattle for export will be made. The extensive areas of rich growths of grass and the absence of storms in the winter make many sections of the country ideal places for ranching. The present summer is seeing an important step being taken in this connection. Several large stock-growers of Washington State are planning to convert the Aleutian Islands into vast cattle and sheep ranges, which will surpass in extent the rapidly diminishing ranges of Montana and Texas. One company has already begun the shipment of 25,000 sheep and 5,000 head of cattle to the Aleutians, a first consignment of 8,000 head of

sheep having recently been sent from San Francisco. The company had previously demonstrated that sheep will thrive there, living throughout the winter solely on the grass of the islands, by having landed 1,000 head there about a year and a half ago.

The rapidly increasing importance of the North has made the United States government decide to establish a coaling station at Dutch Harbor (q.v.), the present end of the cable from Seattle.

In 1892 the total foreign trade of Alaska — by which is meant imports and exports of merchandise — amounted to but $28,366, of which the larger part were imports. In 1900 the total trade was little less than $1,000,000. For the fiscal year ending 30 June 1903, Alaska's foreign trade reached a total of more than $22,000,000, of which the exports were about $13,000,000. With the gold and silver added, the exports would have exceeded $26,000,000, making the total foreign trade $35,000,000. The importation of iron and steel products into the Territory during the year exceeded in value $2,000,000.

And yet the development of the North has only begun. Its immense wealth of fisheries and of timber has been but little exploited; its possibilities for agriculture have not even been attempted. Only the industry in furs and its gold mines have received general recognition. When the cod banks of the coast have been exploited; the salmon industry placed on a more systematic basis; the deposits of gold, iron, nickel, copper, and coal worked by adequate modern machinery; the vast tracts of fertile land brought under cultivation, and the railroads briefly indicated in the foregoing sketch have been completed, the great North will be no longer the lone *terra incognita of* the past, but will throb with an active and productive civilization.

In the steady stream of population northward there is nothing known of the limits of nationality. There are more of American birth in Dawson than there are Canadians. Even in the great wheat lands of Manitoba the farmers from Dakota, Montana, and the other States of the North and West almost equal in numbers those of Canadian origin. The explanation is simple. With its population of 90,000,000 the United States can send forth its pioneers in the ratio of thirteen to one from the provinces of the Dominion. Loyalty to British connection will not prevent the spread of American influence and the growth of American ideals of government. The entire Canadian Northwest is already more American than British in its administrative systems.

Shut off, industrially, from the east of Canada by the uninhabited and not very cultivable strip north of Lake Superior and Georgian Bay, northwestern Canada must make its commerce with the northwestern States and with Alaska. From south, west, and north, therefore, the influences will be wholly American, while within its boundaries American capital and American settlers will spread the leaven of the genius of American institutions. A few years ago it was the custom to laugh at the purchase of Alaska as having been, somewhat politely, forced upon the United States by Russia as a return for her supposed friendship during the Civil War. The laugh is no longer appropriate. Larger in area than the combined States of Alabama, Connecticut, Delaware, Indiana, Indian Territory, Kentucky, Louisiana, Maine, Maryland, Mississippi, Rhode Island, New Jersey, New York, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia, or than the British Isles, France, Germany, Portugal, and Belgium together. Alaska, already an important part of the United States, will contribute largely to a social and commercial, if not a political, union of two nations.

William R. Stewart.
Editorial Staff 'New York Daily News.'

Alaskan Boundary Commission, a mixed tribunal which met in London, England, 3 Sept. 1903 to arbitrate on the contentions of the Canadian government with regard to the boundary line between Alaska and Canada, from Mount St. Elias to the Portland Canal. The commission consisted of three Americans and three Britons, the American commissioners being Secretary Root, Senators Lodge and Turner, while the British commissioners were Lord Alverstone (formery Sir Richard Webster), English, Sir Louis Jetté, and Mr. A. B. Aylesworth, Canadians. Ex-Secretary Foster was agent for the American government and Mr. Clifford Sifton for the British government.

In May 1898 the United States and Great Britain agreed to appoint an Anglo-American Joint High Commission to consider and put on a satisfactory basis the regulations of the North Atlantic fisheries, commercial reciprocity, the Bering Sea fishery question, and other disputes which disturbed relations between the United States and Canada. When the questions for the deliberation of this commission were fixed, no mention was made by Great Britain of any divergence of opinion regarding the Alaskan boundary.— but on 1 Aug. 1898 the British government informed the United States that a difference of views existed as to the provisions of the treaty of 1825, which defined the Anglo-Russian boundary. On 23 August Great Britain submitted its claims, enumerated below. It was proposed to arbitrate the matter, but the High Joint Commission could not agree. The United States rejected a European umpire for American territory and the Canadians would not agree to an American judge. The final compromise was the above-mentioned tribunal.

Previous to the discovery of gold in the Yukon region there was no dispute, or occasion for dispute, as to the course of the boundary line defined by the Anglo-Russian treaty of 1825. For 73 years it had been tacitly recognized by all nations, including Great Britain. The history of that treaty is interesting. The government of the czar had from time to time by ukase asserted exclusive jurisdiction over the coast lands and the waters of Alaska, to prevent any encroachment by the British Hudson's Bay Company upon the monopoly of the Russian-American Fur Company which had established its stations and carried on its trade in the islands and along the coast of Alaska extending northward from the Portland Canal. Disputes arose, and in the attempt to settle them the negotiations were begun which led to the signing of the treaty of 1825. The purpose of Russia in that negotiation was altogether to shut out Great Britain from the coast and the waters in which the Russian company was carrying on its business. The attempt of Great Britain was to secure a foothold upon the coast with the obvious

purpose of getting an opportunity for the Hudson's Bay Company to establish its stations there, which was the very thing Russia sought to prevent.

The negotiations lasted from 1822 to 1825, Count Nesselbrode and M. de Poletica conducting the Russian case, and Sir Charles Bagot first, and Lord Stratford de Redcliffe finally, the British case. At that time Great Britain feared that the United States would insist upon retaining possession of the whole Oregon territory up to the Russian line at the historic parallel of 50° 40'. This would have shut off Canada from the Pacific coast entirely, and the British, therefore, made strenuous efforts to get an outlet through the Russian coast strip, making various propositions, one after the other which the Russians rejected, stubbornly adhering to their original proposition, which in the end prevailed.

The British first asked to have the boundary line drawn straight down the 141st meridian to the sea at Mount St. Elias, thus depriving Russia of the entire "panhandle" of Alaska, and causing her even to relinquish Sitka, the colonial capital. This was peremptorily rejected by Russia without serious consideration. The British next proposed Christian Sound, Chatham Strait, and Lynn Canal as the boundary, leaving Baranoff Island to Russia, but giving to the British Juneau, Admiralty Island, and everything to the south and east thereof. This was also rejected. Then Clarence Strait and the Stikine River were proposed, leaving Prince of Wales Island to Russia, but giving to Great Britain the islands of Wrangell and Revilla-Gigedo. This also the Russians rejected. Finally the British commissioners conceded to Russia the whole strip down to 54° 40', but sought as a last resort to have the coast line drawn straight across such arms of the sea as Glacier Bay and Lynn Canal, from headland to headland, so as to give the British access to tidewater. This, too, the Russians, inexorably refused to grant, and in the end they won on this point as on all the others. From first to last the constant and inflexible Russian contention was for Russian possession of an unbroken strip of coast from Mount St. Elias to Portland Canal, and in the treaty of 1825 that contention was explicitly upheld and confirmed.

That Russian title was transferred to the United States in 1867, and from that time to the present the United States has stood for precisely what Russia stood for in 1822–5.

In 1898, however, as already stated, following the discovery, in 1896, of the rich gold deposits in the Klondike district, the Canadian government set up a claim based upon a new understanding of the Anglo-Russian treaty. The main contention, which, by the way, never had any cordial support from qualified experts in Great Britain, was whether the line of demarkation between the southeastern end of Alaska and the British northwest possessions cut through the inlets and estuaries of the Pacific or went around them, leaving all these waterways in American territory and preventing Great Britain from access to the sea. The British contended that the boundary line, which was defined by treaty as running parallel with the sinuosities of the coast at a distance of 30 marine miles inland, except where parallel mountain ranges were nearer, when it was to follow these ranges, was to be construed as running parallel to the coast of the Pacific and not parallel to the shores of the inlets of that sea, thus constituting a political rather than a physical coast line. If the British contention had been granted, Dyea and Skagway, two important ports on the Lynn Canal, and the prominent places of export and import for the Yukon and Klondike gold fields, would be in Canadian territory. So would the Porcupine gold fields.

On account of the apparent clearness of the terms of the Anglo-Russian treaty in 1825 it may seem difficult to imagine how any interpretation different from that argued for by the United States could have been put forth. The original treaty, however, was in French, and dispute arose as to the precise translation of "crête," meaning crest, "lisière," meaning strip, and "côte," usually translated as coast.

The treaty also laid down the boundary on supposed topographical conditions which did not exist. When the treaty was drawn up the framers relied upon some of the maps of Capt. Vancouver, and from observations in the small section of British Columbia which he explored it seemed apparent that the whole coast was bordered by a range of mountains which ran parallel to and at a distance of from 25 to 30 miles from the sea.

As a matter of fact there is a jumble of mountains in various places along the coast, but in no case is there a well-defined watershed. The "crests" mentioned in the treaty were even more difficult to decide upon, and with the difference of opinion as to whether the coast line as intended in the treaty ran through the inlets or around them there were grounds for disputes, for the settlement of which an international tribunal became necessary.

The treaty between the United States and Great Britain, of which the appointment of the Alaska tribunal was the consequence, therefore decided that the following questions should be decided upon:

1. What is intended as the point of commencement of the line?

2. What channel is the Portland channel?

3. What course should the line take from the point of commencement to the entrance to Portland channel?

4. To what point on the 56th parallel is the line to be drawn from the head of the Portland channel, and what course should it follow between these points?

5. In extending the line of demarkation northward from said point on the parallel of the 56th degree of north latitude, following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of longitude west of Greenwich, subject to the condition that if such line should anywhere exceed the distance of 10 marine leagues from the ocean then the boundary between the British and the Russian Territory should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 marine leagues, was it the intention and meaning of said convention of 1825 that there should remain in the exclusive possession of Russia a continuous fringe or strip of coast on the mainland, not exceeding 10 marine leagues in width, separating the British possessions from the bays, ports, inlets, havens, and water of the ocean, and extending from the said point on the 56th degree of latitude north to a point where such line of demark-

ation should intersect the 141st degree of longitude west of the meridian of Greenwich?

6. If the foregoing question should be answered in the negative, and in the event of the summit of such mountains proving to be in places more than 10 marine leagues from the coast, should the width of the "lisière" which was to belong to Russia be measured (1) from the mainland coast of the ocean, strictly so-called, along a line perpendicular thereto, or (2) was it the intention and meaning of the said convention that where the mainland coast is indented by deep inlets, forming part of the territorial waters of Russia, the width of the lisière was to be measured (*a*) from the line of the general direction of the mainland coast, or (*b*) from the line separating the waters of the ocean from the territorial waters of Russia, or (*c*) from the heads of the aforesaid inlets?

7. What, if any exist, are the mountains referred to as situated parallel to the coast, which mountains, when within 10 marine leagues from the coast are declared to form the eastern boundary?

The United States made no actual claim. She reiterated her right to territory which she proved had been recognized as hers by Great Britain and by various official acts of Canada. Various maps were produced to show that Russia had been entitled to the disputed territory and that after the purchase of Alaska that same territory was mapped and charted as belonging to the United States.

Among the maps put in evidence was the British Admiralty Chart No. 787, corrected to April 1898, in which the boundary line follows the sinuosities of the actual sea-coast, and deprives Canada of the inlets which cut into the continent. It was proven also that post-offices have been maintained on various points of the disputed strip; that custom-houses have been established there and have collected duties, and that government and mission schools, particularly at the head of the Lynn Canal have been maintained for nearly 20 years. The fact that the possession of the territory by Russians and later by Americans had not been disputed from 1825 until 1898, was also put forth by the United States in support of her claim.

The British contention rested primarily on the claim that it would have been impossible to trace at a distance of 30 miles the intricate convolutions of the line forming the edge of the salt water, and that therefore a general coast line, including many of the islands and disregarding many of the inlets, was the intention of the framers of the Anglo-Russian treaty. If the 30-mile limit were applied to such a coast, the boundary line would of course cut across all the deeper inlets, giving the British immediate access to the interior.

The British also submitted an argument placing a new interpretation of that clause of the treaty which provides that where the boundary line follows the mountain ranges, the crests of these mountain peaks shall mark the precise line of demarkation. It was demonstrated in the rush to the Klondike that there was no general line of mountains anywhere near the coast, but a number of peaks and small mountains were scattered disconnected close along the coast.

The British claim that the boundary line should follow the crests of these isolated peaks, had it been allowed, would have deprived the United States of a great portion of their 30-mile "lisière." The British cited the action of American surveyors in 1893 in support of their interpretation of "coast."

Dr. T. C. Mendenhall, superintendent of the United States Coast and Geodetic Survey, in that year directed his subordinates to carry their operations inland "30 nautical miles from the coast of the mainland in a direction at right angles to its general trend." In regard to the mountains it was contended that a gap does not discontinue the general line of the range.

The official report of the tribunal was signed and issued on 20 Oct. 1903. The signatories were Lord Alverstone, the British commissioner, and the three American commissioners, who constituted a majority of the tribunal, the Canadian commissioners refusing to sign.

All the American claims were granted with the exception of those in regard to questions 2 and 3, in which the British contentions were upheld. The original treaty specified that the line should run from the southernmost point of Prince of Wales Island (Cape Muzon) to Portland Channel. The course of this line, according to the United States, is due east about 70 miles.

The British locate it a little north of east about 66 miles to what they call Portland Channel, and what the Americans call Pearse Channel. The American claim is made on the map of Capt. Vancouver, who first scientifically investigated the territory, and the British claim was made upon the text of Capt. Vancouver's book, which differed slightly from the map.

A substantiation of the American contention would have given to the United States Pearse and Sitklan Islands, which command the entrance to Fort Simpson, to which point Canada proposes to build a new transcontinental railway.

The decision in regard to Portland Channel or Canal gave Canada Pearse and Wales Islands, while the United States obtained Sitklan and Kunnughunnut Islands and the broad southern portion of the channel. Three opinions were also delivered to Messrs. J. W. Foster and Clifford Sifton, the agents respectively of the United States and Canada, one by the United States commissioners discussing the Portland Canal claims; another by Lord Alverstone on the general issue, and a third by the Canadians protesting in the most emphatic language against all the American claims. The chief interest in the decision lay in the conclusions upon the fifth or main question of Lord Alverstone, who by his impartial and high-minded course refuted the assumption on which was based the principal objection to the former treaty, that not even on the bench could a British subject be found who would not persist in upholding the supposed interests of his country, no matter how cogent might be the appeals to his sense of justice or of equity.

The following is an abstract of Lord Alverstone's conclusions:

"The broad, undisputed facts are that the parties were engaged in making an agreement respecting the archipelago and islands off the coast and some strip of land upon the coast itself. The western limit of these islands extends in some places about 100 miles from the coast and the channels or passages between the islands and between the islands and the coast

are narrow waters, their widths varying from a few hundred yards to 13 miles.

"In ordinary parlance no one would call the waters of any of these channels or inlets the ocean. I agree with you as presented on behalf of Great Britain that no one coming from the interior and reaching any of these channels, particularly the head of Lynn Canal or Taku Inlet, would describe himself as being upon the ocean, but on the other hand, it is quite clear that the treaty does regard some of these channels as the ocean. This consideration, however, is not sufficient to solve the question. It still leaves open the interpretation of the word coast, to which the mountains were to be parallel. * * *

"There is, so far as I know, no recognized rule of international law which would by implication give a recognized meaning to the word coast as applied to such sinuosities and such waters different from the coast itself. As I have said more than once, the *locus in quo* to which the treaty was referring precludes the possibility of construing the word coast in any particular article in any special way if it does not refer to the coast line of the continent. I think the words upon the border of the continent comprised within the limits of the Russian possessions in Article V. rather confirm the view that Russia was to get a strip all along the continent, but I do not think that much reliance can be placed upon this because of the provision regarding the rivers and streams in Article VI.

"Turning from the language of the treaty to the record of the negotiations, I have been unable to find any passage supporting the view that Great Britain was directly or indirectly putting forward a claim to the shores or ports at the head of inlets. This is not remarkable inasmuch as no one at that time had any idea that they would become of any importance. * * * The language of both the British and Russian representatives in reporting the conclusion of the treaty to their respective governments is in accordance with the view I have suggested. * * * I have little doubt that if shortly after making the treaty in 1825 Great Britain and Russia had proceeded to draw the boundary provided by the treaty, the difficulties and in certain events the impossibilities of drawing the boundary in strict accordance with the treaty would have been evident.

"I can, therefore, understand and appreciate the contention of Great Britain that under existing circumstances difficulties in delineating the boundaries described must arise in one view and might arise in any view. But these contentions, strong as they are in favor of a just and equitable modification of the treaty, do not, in my opinion, enable one to put a different construction upon the treaty. I think the parties knew and understood what they were bargaining about and expressed the terms of their bargain in terms to which effect can be given. The fact that when, 75 years later, the representatives of the two nations attempted to draw the boundary in accordance with the treaty they were unable to agree as to its meaning does not entitle me to put a different construction upon it.

"In the view I take of the terms of the treaty itself it is unnecessary to discuss the subsequent action. Had the terms of the treaty led me to a different conclusion and entitled me to adopt the view prescribed by Great Britain, I should have felt great difficulty in holding that anything done or omitted to have been done, by or on behalf of Great Britain, prevented her from insisting upon a strict interpretation of the treaty, nor do I think the representations of the map-makers that the boundary was assumed to run around the heads of the inlets could have been properly urged by the United States as sufficient reason for depriving Great Britain of any rights she had under the treaty had they existed."

Alaskan Blackfish, Greenfish, etc. See Blackfish, etc.

Alassio, ä-läs'sē-ō, a small seaport in the province of Genoa, Italy, situated on the Gulf of Genoa, about 48 m. S.W. of the city of Genoa.

Alastor, in Greek mythology, a surname given to Zeus as the avenger; also the name of an avenging demon who follows the sinner and drives him to fresh crime. In the Middle Ages the name was given to a house-demon, the skeleton in the cupboard.

Alatan, a range of mountains in central Asia, forming the boundary between Mongolia and Turkestan.

Alatyr, á-lá-tir', a town in Russia, government Simbirsk, at the confluence of the Alatyr with the Sura, with a considerable trade. Pop. 12,000.

Alau'da, a genus of insessorial birds, which includes the larks. See Lark.

Alaux, al-ō', **Jean,** called "Le Romain," a French painter: b. in Bordeaux 1786; d. 3 March 1864. He was a pupil of Vincent and Guérin; in 1815 took the Prix de Rome with the painting of 'Briseis Finding the Body of Patroclus in the Tent of Achilles.' He executed many portraits and other works. His historical paintings in the Museum of Versailles are famous: 'Battle of Villaviciosa,' 'Valenciennes Taken by Assault by Louis XIV.,' 'States-General of Paris under Philippe de Valois,' 'Assembly of Notables at Rouen under Henry IV.,' 'States-General of Paris under Louis XIII.,' and the 'Reading of the Will of Louis XIV.' He spent nine years in painting the 86 pictures which decorate the hall of the States-General of Paris. He was director of the Academy of France from 1847 to 1850, and in 1851 became a member of the Academy. His brother, Jean Paul Alaux, called "Le Gentil," born in 1788, was director of the School of Design at Bordeaux.

A'lava, a hilly province in the north of Spain, one of the three Basque provinces; area, 1,207 square miles; covered by branches of the Pyrenees, the mountains being clothed with oak, chestnut, and other timber, and the valleys yielding grain, vegetables, and abundance of fruits. There are iron and copper mines, and inexhaustible salt springs. Capital, Vittoria. Pop. about 95,000.

Alb (from Lat. *albus,* white), a clerical vestment worn by priests while officiating in the more solemn functions of divine service. It is a long robe of white linen reaching to the feet, bound round the waist by a cincture, and fitting more closely to the body than the surplice.

Alba, the name of several towns in ancient Italy, the most celebrated of which was Alba Longa, a considerable city of Latium, according to tradition built by Ascanius, the son of Æneas, 300 years before the foundation of Rome. It was at one time the most powerful city of Latium, and the head of a league of the Latin cities, but fell during the reign of Tullus Hostilius, when the town was destroyed and the inhabitants removed to Rome. In later times the site of the ancient Alba Longa became covered with villas of wealthy Romans, whence arose the municipium of Albanum, now Albano (which see). Another Alba, called Alba Fucentia or Fucentis, was near the Lacus Fucinus. The cyclopean walls of the old town are still to be seen in excellent preservation.

Alba, Duke of. See ALVA.

Albacete, a town in Spain, capital of the province of the same name, on the highway between Madrid and Cartagena, on an important line of railway. It lies in a fertile but treeless plain. Albacete, from its position, is a place of considerable business; and carries on trade, both direct and transit, with Murcia, Alicante, Valencia, and Madrid, exporting grain, saffron, and cattle; and importing codfish, sardines, rice, sugar, wine, iron, cloths, etc. A good deal of cutlery is made here.

Alba Longa. See ALBA.

Alban, Saint, protomartyr of Britain, 303. A native of Hertfordshire, he was tortured and executed at Verulamium by command of the prefect, Asclepiodotus. When tranquillity was restored a chapel was erected over his grave; in 795, Offa, king of the Mercians, founded a large monastery upon the spot, and Pope Adrian IV. (1154–9) directed that he should hold the first place among the abbots of England. His festival is celebrated by the Roman Catholic Church on 22 June, and by the Anglican Church on 17 June.

Albani, a powerful family of Rome, which has supplied the Roman Catholic Church with several cardinals. Two of them are well known as patrons of the fine arts: (1) ALBANI, ALESSANDRO, born in 1692; died in 1779; he was a great virtuoso, and possessed a collection of drawings and engravings which at his death was purchased by George III. for 14,000 crowns. (2) ALBANI, GIOVANNI FRANCESCO, nephew of the former, born in 1720; a great friend of the Jesuits, and in every respect liberal and enlightened. His palace was plundered by the French in 1798, when he made his escape to Naples stripped of all his possessions. Died in 1803.

Albani, Francesco, a famous painter: b. Bologna 1578; d. 1660. He entered the school of Dionysius Calvaert, a Flemish painter, who had a great reputation in Bologna. Albani was one of his most distinguished scholars, but quitted him for Ludovico Carracci, under whose instruction he made rapid progress. He labored here several years in connection with Domenichino, to whom he was closely attached by friendship and love of art; and some resemblance is perceptible in their manner of coloring. But in invention he surpasses his friend, and indeed all his rivals of the school of Calvaert. His female forms Mengs places above those of all other painters. Among the best known of his compositions are the ‹Sleeping Venus,› ‹Diana in the Bath,› ‹Danaë Reclining,› ‹Galatea on the Sea,› ‹Europa on the Bull.› Scriptural subjects he has less frequently selected, but when he has, the paintings are principally distinguished for the beauty of the heads of the angels. He had a numerous school in Rome and Bologna. The scholars of Guido, with whom he vied, accused him of effeminacy and weakness of style, and maintained that he knew not how to give any dignity to male figures. He has been called the Anacreon of painters.

Albani, Marie Emma (Lajeunesse), a dramatic soprano and opera singer: b. 1 Nov. 1852, in Chambly, near Montreal, Canada. After studying with Lamperti, at Milan, she made her début at Messina (1870), in 'La Sonnambula,' under the name of Albani, in compliment to the city of Albany, where her public career began. In 1878 she married Ernest Gye of the Covent Garden Theatre.

Albania, an extensive region in west European Turkey between the Adriatic Sea, Greece, Macedonia, and Montenegro. Upper or northern Albania formed a part of the Illyria of the Romans; lower or southern Albania corresponds to ancient Epirus. It comprises the vilayets of Scutari and Janina and parts of Monastir and Kossovo. It forms the southwestern portion of the remaining immediate possessions of European Turkey, and extends along the western shore of the Balkan peninsula, from the river Bojana to the Gulf of Arta. To the north it is bounded, since 1878–80, by the newly won Montenegrin territory and by Bosnia; on the south it is separated, since 1881, from Greece by the river Arta. The eastern boundary is a mountain range, which to the north attains an altitude of 7,990 feet. Westward of this range lie parallel chains enclosing long, elevated valleys sinking to level strips along the coast, which mostly consist of unhealthy swamps and lagoons. The highlands advance to the sea, forming steep, rocky coasts. One promontory, the Acroceraunian, projecting in Cape Linguetta far into the sea, reaches a height of 6,642 feet. There are three lakes, Scutari, Ochrida, and Janina. The principal rivers are the Boyana, Drin, Shkumbi, and Artino. A fine climate and a favorable soil would seem to invite the inhabitants to agriculture, but in the north little is cultivated but maize, with some rice and barley in the valleys; the mountain terraces are used as pastures for numerous herds of cattle and sheep. In the south the slopes of the lower valleys are covered with olives, fruit, and mulberry trees, intermixed with patches of vines and maize, while the densely wooded mountain ridges furnish valuable supplies of timber. The plateau of Janina yields abundance of grain; and in the valleys opening to the south the finer fruits are produced, along with maize, rice, and wheat. The inhabitants form a peculiar people, the Albanians, called by the Turks Arnauts, and by themselves Skipetar.

They are half-civilized mountaineers, frank to a friend, vindictive to an enemy. They are constantly under arms, and are more devoted to robbery than to cattle-rearing and agriculture. They live in perpetual anarchy, every village being at war with its neighbor. Many of them serve as mercenaries in other countries, and

they form the best soldiers of the Turkish army. At one time the Albanians were all Christians; but after the death of their last chief, the hero Skanderbeg, in 1467, and their subjugation by the Turks, a large part became Mohammedans. Their language is one of the eight chief Indo-Germanic g oups, and represents the ancient Illyrian; it is found not only in Albania, but in southern Italy and Sicily. The former notion that its affinities were prevailingly Greek was derived from the number of Greek loan-words in its southern branch, the Toskish, the northern and more primitive being called Gegish: the affiliation of the whole is rather to Slavic than any other. While retaining its grammatical structure, its vocabulary has been largely transformed by borrowing from neighbors; Latin most, then Greek, Slavic, and Turkish. It has almost no literature except folk songs and tales. The Gegish uses the Roman alphabet, the Toskish the Greek, with some changes.

Albans, St. See St. Albans.

Albany, Louisa Maria Caroline, or **Aloysia,** Countess of, a princess of the Stolberg-Gedern family: b. 1753; d. 29 Jan. 1824. She married in 1772, the English pretender, Charles Edward Stuart, after which event she bore the above title. Her marriage was unfruitful and unhappy. To escape from the barbarity of her husband, she retired, in 1780, to a cloister, and afterward to the house of her brother-in-law at Rome, where she met the poet Alfieri, to whom, soon after the death of her husband, she was privately married. Alfieri attributed to her his poetic inspiration. (See Alfieri.) She died at Florence, her usual place of residence, in her 72d year. Her ashes and those of Alfieri now repose under a common monument in the church of Santa Croce at Florence.

Albany, Ga., county-seat of Dougherty County, on the Albany & North Seaboard Air Line, Central Ga., and Plant System R.R.'s, at the head of navigation on the Flint River, about 175 m. W. from Savannah. The city has large manufacturing interests, and is the centre of one of the most productive agricultural regions in the State. It is governed by a mayor and a council. Pop. (1900) 4,606.

Albany, Mo., city and county-seat of Gentry County, on the Chicago, B. & Q. R.R., about 82 m. N.E. from Kansas City. The Central Christian College and the Northwest Missouri College are situated there. The city, first settled in 1845, has a mayor and council. Pop. (1900) 2,025.

Albany, N. Y., State capital and seat of Albany County, on the right (west) bank of the Hudson, 143 miles north of New York, 200 miles west of Boston, 297 miles east of Buffalo. Besides its political importance as the capital, its commercial and manufacturing status is high. Of old for many years the starting point of all the enormous eastern travel and traffic to the Great West, over the Erie Canal (q.v.), connecting it with the Great Lakes at Lake Erie; it is still an important port and the intersecting point of the great western as well as northern rail and water routes. With New York and the ocean it is connected by the imperial Hudson, of which it is the head of navigation for large steamers (smaller ones going on to Troy, six miles above). The Erie Canal is still a great commercial advantage, and will soon be more so; while the Champlain Canal gives access not only to western Vermont, but to the St. Lawrence and the heart of Canada, with the foreign business centring at Montreal. By rail it joins the western and northern traffic of the New York Central Railroad system (the Adirondack region, Vermont, and Canada) and that of the Delaware & Hudson Railroad with the western traffic of central New England over the Boston & Albany branch of the New York Central road, the Fitchburgh branch of the Boston & Maine Railroad and the Rutland Railroad.

Trade and Manufacturing.— The through freight lines now leave little transhipment to be done at Albany, though it still remains an important passenger centre; but commerce and industries are conservative, and it retains much of both given it by its position in earlier times, as a distributing point and terminal. In particular, the great Canadian and Adirondack forests to the north have made it an immense lumber port. Its manufactures are of wide and well-known importance, the greatest being iron goods,— foundries and stove works,— wood and brass; combined wood and metal, as carriages and wagons; brick; shirts, collars, and cuffs; clothing and knit goods; shoes; flour; tobacco and cigars; and brewery products; billiard balls; dominoes; checkers and embossed blocks.

In 1900 the city contained 1,566 manufacturing establishments with $21,328,764 capital, employing 14,092 persons, paying $7,127,864 in wages and $11,121,501 for materials, and having a total output of $24,992,021.

Finances.— The assessed valuation of taxable property in 1903 was $68,672,887 and the net public debt in 1903 was $1,318,435. The annual and municipal outlay is about $2,600,000, of which $300,000 is for schools, $157,000 for police and $150,000 for the fire department. There are six national banks, with aggregate capital of $1,750,000, two trust companies with a capital, surplus and profits of $1,135,000, and seven savings banks with a surplus (at market value) of $4,621,941, and amount of deposits of $55,496,220.

Interior.— The city has a river frontage of four miles, and extends west five miles from a narrow alluvial strip often flooded in the spring, over a steep rise to a sandy table-land 150 to 200 feet above tide-water, divided into four elevations and their corresponding valleys. It has 85 miles of streets, paved with granite, asphalt, and brick; gas and electric light plants; and over 30 miles of electric street railways within its limits, several suburban lines running to towns at a distance, centring in Albany: these lines reach Troy, Cohoes, Saratoga, Glens Falls, Lake George and Warrensburgh in the north, a distance of 71 miles. Sand Lake in the northeast, a distance of 15 miles; Schenectady, Amsterdam, Johnstown, and Gloversville in the west, a distance of 50 miles, and Hudson in the south, a distance of 38 miles. The river is crossed by two railroad and foot bridges and one wagon bridge to Rensselaer (formerly Greenbush). The water supply is partly taken by gravity from an artificial lake five miles west, and partly pumped from the river, with a public filtration system. This plant covers 20 acres of ground, has eight filter beds and filters 15,000,000 gallons of water daily. The parks, 11 in num-

THE STATE CAPITOL AT ALBANY.

ber, contain 305 acres; the largest is Washington Park of 90 acres with a lake 1,700 feet long. This park contains the celebrated 'Burns' statue by Charles Calverly and the bronze and rock fountain 'Moses Smiting the Rock' by J. Massey Rhind. The three cemeteries cover 440 acres. President Arthur's tomb is in the handsome Rural cemetery of 280 acres, situated four miles north of the city.

Buildings.— The great show building of Albany is the magnificent capitol, begun in 1871 and continued by several different architects at a total outlay to date of some $25,000,000. The lack of unity in plan makes itself perceptible both in looks and cost, millions have been spent in alterations and reconstructions, and some of the mechanical work and material have been poor; but though more might have been obtained for the money, the capitol is a noble structure. It is of Maine granite, in the Renaissance style; is 300 x 400 feet and covers more than three acres; it occupies a most sightly position on the hillside facing the river, and including part of the site of the old capitol built in 1806. Besides its rooms for the legislative bodies and officials and the court of appeals, it contains the magnificent State library of over 450,000 volumes, and many interesting relics of the Revolution and Civil War. The grand western staircase in the western end of the building is said to be the finest staircase in the world: it cost nearly two millions of dollars.

The State Hall and the City Hall face it; the former of white marble, and the latter of red sandstone with grand campaniles and Romanesque doorways. The custom-house and post-office are in the government building at the foot of State Street. Among other buildings are the State Arsenal, Harmanus Bleecker Hall, the old Schuyler mansion, now used as an orphan asylum, and the Agricultural and Geological hall. In 1893 the second Van Rensselaer manor-house, built 1765, was removed to the Williams College campus, of Williamstown, Mass.

The buildings of religious and educational institutions are also creditable features: Albany is the seat of both Roman Catholic and Protestant Episcopal bishoprics, and has over 70 churches. Very notable are the cathedrals of the Immaculate Conception (R. C.) and All Saints (P. E.). St. Peter's Church (P. E.) is reputed one of the finest specimens of the French Gothic type of architecture in the United States.

The Madison Avenue and First Reformed churches were organized in 1642, incorporated in 1720 and continued as one church until 1799, when separate edifices were built; these two churches continued under one government until 1815.

The public school property is valued at nearly $1,000,000. Other institutions of learning are the law and medical departments of the Union University at Schenectady (originally independent academies of 1851 and 1839), Albany Academy, the State Normal College, St. Agnes School, the Albany Female Academy, and the Convent of the Sacred Heart. Also the Dudley Observatory and the Bender Hygienic Laboratory. Albany has a fine city hospital built in 1899 on the pavilion plan and covering 16 acres with 150,000 feet of floor space; the Albany penitentiary, dating from 1848 — from three to four hundred prisoners a year are confined in this institution.

Government.— Biennial mayor; city council, the president elected at large, the aldermen by wards; and boards of finance, public works, public safety, assessment and taxation, charities and correction, judiciary, and law. For their composition, see statutes of New York State, cities of the second class. The mayor also appoints a sealer of weights and measures, and supervisors are elected.

Population.— In 1800, 5,289; 1820, 12,630; 1840, 33,721; 1860, 62,367; 1880, 90,758; 1890, 94,923; 1900, 94,151 (17,700 foreign).

History.— Albany, as an old frontier town and strategic post against the French settlements in the 18th century wars, is of much historic interest. Next to Jamestown, Va., and St. Augustine, Fla., it was the oldest settlement in the Union; if the 13 colonies only are included, and Jamestown thrown out as deserted since 1676, it may perhaps be called the oldest with a continuous life, though its actual settlement as a residence is later than Plymouth. (For early discovery, see AMERICA; HUDSON; VERASSANO.) About 1540 a French trading-post was set up there for a time. In 1614 the Dutch, following Hudson's lead, established a factory, on Castle Island, called Fort Nassau, in 1617 removed to the mainland and called Beverwyck. The first settlers were 18 Walloon families (Huguenot refugees from Belgium — Peter Minuit, the first director-general of New Amsterdam, was a Walloon), and Fort Orange (Latinized Aurania) was built the same year, near the present capitol. In 1626 a war with the Mohawks forced the temporary abandonment of the village. In 1629 Killian Van Rensselaer, having obtained from the Dutch government a large land-grant near by, colonized it with Dutch settlers and rented the land to them as patroon. (See ANTI-RENT WAR; PATROON.) This, as always, ended in a chronic dispute over the extent of his legal rights and jurisdiction, which was not settled till after the ownership of the Dutch settlements was transferred by the English conquest to the Duke of York and Albany (later James II.) after whom Fort Orange was renamed. In 1686 it received a city charter (its bi-centennial was celebrated in 1886) from Gov. Thomas Dongan; its first mayor (appointed by the governor, though the council was elected) was Peter Schuyler. The English settlers rapidly increased, but Albany was long a Dutch city. In the French and Indian wars it was a stockaded rendezvous, arsenal, and hospital, the refuge of the border. In 1754 it was the meeting-place of the first Provincial Congress, which formed "a plan of a proposed union of the several colonies" (see ALBANY CONGRESS). In 1777 it was Burgoyne's objective point, where he was to meet the expeditions up the river and from Canada. After being for many years later the occasional seat of State government, it became the permanent capital in 1797, the centennial of which it celebrated 6 Jan. 1897. Its rapid growth began with the opening of the Erie Canal in 1825, making it the terminal for western business. Within 35 years it had increased fivefold. In 1848 it was partially destroyed by fire.

WILLIAM BOUCHER JONES,
Secretary Albany Chamber of Commerce.

Albany, Ore., city and county-seat of Linn County, on the Southern Pacific and the Cowalli & E. R.R.'s, and the Willamette River, about 25 m. S. by W. from Salem. The city has good water-power from the Willamette River, and has large manufacturing interests. It ships both grain and flour. Pop. (1900) 3,149.

Albany, West Australia, in Plantagenet co., on King George's Sound. It has one of the finest harbors in Australia, and is a port of call for the steamers of the Peninsular & Oriental Co. It is a consular station of the United States. Pop. about 3,000.

Albany Congress, an assembly of representatives of the seven northern British-American colonies (Massachusetts, New Hampshire, Connecticut, Rhode Island, New York, Pennsylvania, and Maryland), called together in 1754 by the British government to consult in regard to the threatening French war. It met 19 June, and two plans were proposed: (1) a league with the Five Nations, which was carried out; (2) a proposal offered by Franklin for a political union. In this a common president was proposed, and a great council representing the different colonies. The president was to be appointed by the Crown; to be also commander-in-chief, to commission all civil officers and appoint all military ones, and have a veto on the council. The council was to consist of three-year members, two to seven from each colony; not to be adjourned or dissolved or kept over six weeks in session against its will; it could lay taxes, maintain troops, build forts, nominate civil officers, manage Indian affairs, and authorize new settlements; and its acts were to be valid unless vetoed within three years by the Crown. This plan was rejected by the British Crown because it gave too much power to the colonies and by the colonies because it gave too much power to the Crown. The significance of this congress lies in the fact that it stimulated the union of the colonies which was afterward accomplished.

Albany Regency, in American political history, the nickname of a powerful group of Democratic leaders in New York State, who controlled the party machinery there and acted together for influence in State and national affairs about 1820–54: so named because its members either lived near the capital or held offices which made it their headquarters. Its origin and essence as an aristocracy of «bosses» lay in the system of frequent elections among a democracy, which puts nominations into the hands of professionals who will be paid in some shape, creating a permanent standing army of political managers. The Regency was the unofficial staff of this army, and was larger than in other States from the imperial field which New York offered for great careers; but it could not have perpetuated its power but for the means of rewarding friends and punishing enemies given it by the «spoils system» (a name derived from the saying of one of its members, William L. Marcy, in 1833, that «to the victors belong the spoils»). While personally upright, and strong opponents of corruption, they held firmly to this, the very spring of corruption: the giving or taking away of offices, the use of public contracts for printing or other work or supplies, etc. That this was its cement is shown by the fact that after the bitter factional split of 1848 (see BARNBURNERS) had given the other party this patronage to use against it, the Regency was reduced in a few years to unorganized individuals. The members of course kept themselves in high or profitable positions according to their capacities or preferences; several alternating between State and national preferment, but never neglecting the former basis even in the latter service. The earliest and greatest leader was Martin Van Buren, State attorney-general, United States senator 1821–8, resigning to become governor of New York, Jackson's secretary of state, Vice-President, President. Others were William L. Marcy, State comptroller, judge of the New York supreme court, United States senator 1831, resigning 1833 to become governor of New York, Polk's secretary of war, Pierce's secretary of state; Silas Wright, Congressman, State comptroller, United States senator 1833 (succeeding Marcy), resigning 1844 to become governor of New York; John A. Dix, State secretary of state, United States senator 1845–9, Buchanan's secretary of the treasury, again governor of New York 1872–4; Benjamin F. Butler, Van Buren's attorney-general and acting secretary of war; while others held only State offices,— Azariah C. Flagg, State secretary of state and afterward twice comptroller; Edwin Croswell, State printer, editor of the Albany *Argus,* leading Democratic organ; Benjamin Knower, State treasurer; and others held no offices,— Dean Richmond, Roger Skinner, Peter Cagger, Samuel A. Talcott, etc. (Hammond's 'Political History of New York' is a shrewd analysis of State politics from a judicious and experienced observer.) Afterward Samuel J. Tilden, Daniel Manning, and others of high stamp, by sagacity of central management, preserved in a manner the traditions of the older group, though they never had its patronage to use for discipline.

Albatross (corrupted from Portug. *alcatroz,* the cormorant; from Ar. *al,* the; *qadus,* bucket, on account of its pouch), a large, almost exclusively pelagic bird of the family *Diomedeidæ,* a feature of the lonely southern oceans. They are rarely seen on the north Atlantic, but frequent nearly all other seas, and are never seen ashore except on the barren antarctic islands where they breed. They have great powers of flight and follow ships for long distances to pick up offal. Their appetites are rapacious, their natural diet consisting of any fishes, mollusks, or other animal matter which they find at the surface of the water; they do not dive. Sailors are fond of them and have a strong superstition against killing them. Like their allies, the petrels, the albatrosses have three fully-webbed toes, while the hind toe is either entirely wanting or represented by a claw. The bill of an albatross is four inches or more long, very thick, and finished by a powerful hook at the tip. The nostrils open from round horizontal tubes placed one on each side of the bill, but at its base, instead of together on top as with the petrel. The wings are extremely long and pointed, the tail short and somewhat rounded. The feathers of the body form so thick a coat as to withstand both water and

severe, long-continued cold; owing to the extreme length of the wing the number of flight feathers on it is greater than on the wing of any other bird. The single large white egg of the albatross is usually hatched on the bare earth. Two rather small species of albatross, the short-tailed (*Diomedea albatrus*) and the black-footed (*Diomedea nigripes*), occur on the western coasts of North America; these are about three feet long and seven feet across the wings. The sooty albatross (*Phœbetria fuliginosa*), of much the same size, belongs broadly to the Pacific Ocean. There are from seven to nine other species, of which the largest is the wandering albatross (*Diomedea exulans*) of the southern oceans. It is 4 or 5 feet long and 10 to 12 feet from tip to tip of wings. Its color is white, with black bars across the wing coverts and across part of the back. This is probably the best known species in the family.

Albaugh, John, American actor: b. Baltimore, 30 Sept. 1837. Under the management of Joseph Jefferson he made his first appearance in a play called ‘Brutus,’ in 1855. For 13 years he played throughout the United States and in 1868 became manager of various theatres, latterly in Washington and Baltimore. He retired from the stage in 1899 and devoted his leisure to stock-raising.

Albay, a province in the southeast of Luzon, Philippine Islands, and the richest hemp-growing district on the island. It has yielded as much as 40,000 tons of hemp in a season. The province contains a picturesque volcano, Mayon, which has had several destructive eruptions, the last in 1888. In January 1900 Brig.-Gen. William A. Kobbe, United States Volunteers, was appointed military governor of the province and Catanduanes Island, with temporary authority over Samar and Leyte Islands for the purpose of controlling the hemp-growing country and occupying and opening to trade the various hemp ports. The principal towns in the province are Albay (the capital), Tivi, Malinao, Tobaco, Malilipot, Bagacay, Libog, Legaspi, Manito, Libon, Polangui, Ligao, Oas, Guinobatan, Cagsaua, and Camalig. Vicol is almost the exclusive language of the province. The industries are hemp-growing (annual value $4,750,-217), ship-building, gold, silver, coal, and iron mining. Pop. (1900) 195,129.

Albemarle, The, a Confederate ram, which for a long time did great damage among Union shipping, but was finally destroyed by W. B. Cushing (q.v.), who was entrusted at different times with various difficult feats of the sort. Cushing, while the Albemarle was at moorings in the harbor of Plymouth, N. C., on the night of 27 Oct. 1864 entered the harbor and succeeded in blowing up the vessel by means of a torpedo. The Albemarle was rendered completely useless, and Cushing obtained lieutenant-commander's rank and the thanks of Congress for his execution of the exploit.

Albemarle Sound, a shallow and narrow body of water on the coast of North Carolina, separated from the Atlantic Ocean by low sand islands. The greatest depth is about 18 feet, but it is generally so shallow as to be unnavigable except where it has been dredged. The water is generally fresh and is not affected by the tides. It extends directly west from the ocean about 60 miles. It is the outlet of many of the streams of northeastern North Carolina, chief of which are the Roanoke and Chowan.

Alberoni, Giulio, cardinal and minister of the king of Spain: b. Firenzuola, Parma, 1664; d. Rome 1752. He soon gained the favor of powerful patrons, especially the Duke of Vendôme, whom he accompanied to Paris and then to Spain, the Duke being appointed generalissimo of the armies of Philip V. Having made himself a favorite of the Spanish king, he rose to be prime minister, became a cardinal, was all-powerful in Spain after the year 1715, and endeavored to restore it to its ancient splendor. He reformed abuses, created a naval force, organized the Spanish army on the model of the French, and rendered the kingdom of Spain more powerful than it had been since the time of Philip II.

Albert, Prince (ALBERT-FRANCIS-AUGUSTUS-CHARLES-EMMANUEL), Prince of Saxe-Coburg-Gotha, and Prince Consort of England, second son of Ernest I., Duke of Saxe-Coburg, was born at the Rosenau, a castle near Coburg, on 26 Aug. 1819. In 1837 he entered the University of Bonn, where he devoted himself to the studies of political and natural science, history, philosophy, etc., as well as to those of music and painting. On leaving the university he made a tour through the chief cities of Italy with Baron Stockmar. On 10 Feb. 1840 he married his cousin, Queen Victoria of England. An allowance of £30,000 a year was settled upon the prince, who was naturalized by act of Parliament, received the title of Royal Highness by patent, was made a field-marshal, a Knight of the Garter, of the Bath, etc. Other honors were subsequently bestowed upon him, the chief of which was the title of Prince Consort (1857). He always took a deep and active interest in the welfare of the people in general. His services to the cause of science and art were very important; he presided over the commission appointed in 1841 to consider the best means of rebuilding the houses of parliament and the great exhibition of 1851 owed much of its success to his activity, knowledge, and judgment. He died of typhoid fever on 14 Dec. 1861, after a short illness. A collection of his speeches and addresses was published in 1862. A biography of the prince by Sir Theodore Martin has been published in five volumes, London 1875–80.

Albert I., Duke of Prussia, son of Frederick, Margrave of Ansbach and Baireuth, and grandson of Albert Achilles, Elector of Brandenburg: b. 17 May 1490; d. 20 March 1568. In 1511 he was chosen by the Teutonic Knights grand master of their order. Being the son of Sophia, the sister of Sigismund, king of Poland, and descended from one of the most powerful German families, the Knights hoped by his means to be freed from the feudal superiority of Poland and placed under the protection of the empire. Being recognized by Poland he proceeded to Königsberg and assumed the government in 1512. He refused the oath of allegiance to Poland, which the previous grand master had evaded, and prepared for resistance. In 1520, after protracted negotiations, Sigismund attempted to enforce submission by an invasion of the territories of the Order, but the contest was without decisive result, and in

the following year a truce of four years was agreed to at Thorn. The latter years of his reign were troubled with many intrigues, foreign and domestic; in 1532 he was put under the ban of the empire, but succeeded in transmitting his succession to his son.

Albert I., Margrave of Brandenburg, surnamed the Bear, from his heraldic emblem, was the son of Otto the Rich, Count of Ballenstädt. As Marquis of Lusatia he served the Emperor Lothaire with credit in his war with Bohemia. The Diet afterward withdrew Lusatia from him, but the emperor for further services conferred on him in 1134 the margravate of Brandenburg. In 1136–7 he made incursions into the territory of the Wends, who disturbed his government, and checked their disorders. In 1138 the Emperor Conrad conferred on him the duchy of Saxony, of which he had deprived Henry the Proud. This led to a war with Henry, in which Albert was deprived of Brandenburg, but was restored by an armistice negotiated by the ecclesiastical electors. On the death of Henry (1139) he reassumed the title of Duke of Saxony. A combination was then formed against him, which, in spite of the favor of the emperor, reduced him to extremities. Peace was concluded in 1142. Albert resigned Saxony, and Brandenburg was raised to an immediate fief of the empire. He acquired at the same time by inheritance from Przibislas, a Vandal king who had taken his name in baptism, the country between the Elbe and the Oder. He made his new possessions a fief of the empire, and in order the better to guard them removed his residence to Brandenburg. In 1148 he led an expedition into Pomerania, and in the following year induced the duke of that country to embrace Christianity. In 1150 he was raised to the electoral dignity. In 1157 he made a third expedition against the Wends, conquered their country, and colonized it with agriculturists from Germany, Holland, and Zealand. In 1164 he went on a crusade to the Holy Land. Another war broke out between him and Henry, Duke of Saxony, which was terminated to the advantage of the latter in 1168 by the mediation of the Emperor Frederick I. In 1169 Albert remitted his estates to his son. He died in 1170. The origin of Berlin, Kölln, Aken on the Elbe, and other towns, is attributed to the colonies founded by him.

Albert I., Duke of Austria, and afterward emperor of Germany: b. 1248; son of Rudolph of Hapsburg, who had a short time before his death attempted to place the crown on the head of his son. But the electors, tired of his power, and emboldened by his age and infirmities, refused his request and indefinitely postponed the election of a King of the Romans (the title of the designated successor of the emperor). After the death of Rudolph, Albert, who inherited only the military qualities of his father, saw his hereditary possessions, Austria and Styria, rise up in rebellion against him. He quelled by force this revolt, which his avarice and severity had excited: but success increased his presumption. He wished to succeed Rudolph in all his dignities, and without waiting for the decision of the Diet seized the insignia of the empire. This act of violence induced the electors to choose Adolphus of Nassau emperor. The disturbances which had broken out against him in Switzerland, and a disease which deprived him of an eye, made him more humble. He delivered up the insignia and took the oath of allegiance to the new emperor. Adolphus, after a reign of six years, having lost the regard of all the princes of the empire, Albert was elected to succeed him. A battle ensued near Gellheim, in which Adolphus fell by the hand of his adversary. The last barrier had fallen between Albert and the supreme power, but he was conscious of having now an opportunity of displaying his magnanimity. He voluntarily resigned the crown conferred on him by the last election, and as he had anticipated was reelected. His coronation took place at Aix-la-Chapelle in August 1298, and he held his first diet at Nuremberg with the utmost splendor.

But a new storm was gathering over him. The Pope, Boniface VIII., denied the right of the electors to deprive Adolphus of the imperial dignity and bestow it upon one who had caused the death of the legitimate sovereign. He accordingly summoned Albert before him to ask pardon and submit to such penance as he should dictate; he forbade the princes to acknowledge him, and released them from their oath of allegiance. The archbishop of Mainz from a friend became the enemy of Albert and joined the party of the Pope. On the other hand, Albert formed an alliance with Philip le Bel of France, secured the neutrality of Saxony and Brandenburg, and by a sudden irruption into the electorate of Mainz forced the archbishop not only to renounce his alliance with the Pope but to form one with him for the five ensuing years. In April 1301 Boniface forbade all submission to Albert until he would go to Rome and repair his crimes. The next year Albert entered into negotiations with the Pope, in which he again showed the duplicity of his character. He broke his alliance with Philip, acknowledged that the Western Empire was a grant from the Popes to the emperors, that the electors derived their right of choosing from the see of Rome, and promised to defend with arms the rights of the Pope, whenever he should demand it, against any one. As a reward Boniface excommunicated Philip, proclaimed him to have forfeited his crown, and gave the kingdom of France to Albert. Philip in revenge annoyed and persecuted the Pope.

Albert was engaged in unsuccessful wars with Holland, Zealand, Friesland, Hungary, Bohemia, and Thuringia. While preparing to revenge a defeat which he had suffered in Thuringia he received the news of the revolt of the Swiss, and saw himself obliged to direct his forces thither. The revolt of Unterwalden, Schwyz, and Uri had broken out 1 Jan. 1308. Albert had not only foreseen this consequence of his oppression but desired it, in order to have a pretence for subjugating Switzerland entirely to himself. A new act of injustice, however, put an end to his ambition and life. Suabia was the inheritance of John, the son of his younger brother Rudolph. John had repeatedly asserted his right to it, but in vain. When Albert set out for Switzerland John renewed his demand, which was contemptuously rejected by Albert. John, in revenge, conspired with his governor, Walter of Eschenbach, and three friends against the life of Albert. The con-

spirators took advantage of the moment when the emperor, on his way to Rheinfelden, was separated from his train by the river Reuss, and assassinated him. Albert breathed his last, 1 May 1308, in the arms of a poor woman who was sitting on the road.

Albert Lea, Minn., county-seat of Freeborn County, on the Chicago, M. & St. P., the Burlington, C. R. & N., and the Minneapolis & St. L. R.R.'s, about 100 m. S. of St. Paul and 10 m. N. of the boundary of Iowa. The presence of many lakes and artesian wells of chalybeate waters make the city and neighborhood a popular summer resort. It is the market town for a large agricultural and dairy region and has considerable manufacturing interests. It is the seat of a Presbyterian college for women (est. 1855), and a Lutheran Academy. Pop. (1900) 4,500.

Alberta, a Canadian Northwest Territory, created in 1882, and named for H. R. H. Princess Louise, wife of the Marquis of Lorne, then Governor-General. Area, 101,521 sq. m.; chief towns, Calgary, Edmonton, Lethbridge, and Strathcona (q.v.). The southern part is open and rolling, with timber along the streams and in the foot-hills; the northern is more or less timbered throughout. The drainage is about equally northward and eastward through the Athabascan and Saskatchewan river systems; some small streams in the south are of the Missouri system. The winters are mild, with little snow, and the summers hot and dry. The rainfall is small, but the melting snow in the mountains affords an abundance of water for irrigation. The winter storms are severe, but the warm west wind, the Chinook, disperses the snow rapidly, and cattle and horses graze all winter. The soil is good in the northern and eastern parts. Ranching and dairying are the chief industries; extensive irrigation has increased general farming in recent years. The natural resources are coal, petroleum, natural gas, building stone, and gold. The mountain district about Banff has been set apart by the Dominion Government as a national park. Three branches of the Canadian Pacific Railway (q.v.) traverse the territory, and a short independent line connects Lethbridge with the Great Northern Railway at Great Falls, Montana. The projected lines of the Canadian Northern and Grand Trunk Pacific Railways (q.v.) will pass through Edmonton and the northern part. Pop. (1904) about 70,000. On 1 Sept. 1905 the western portion of Athabasca was added to Alberta, thus nearly doubling its area and materially increasing its population.

Alber'tus Magnus, or Albert the Great, Count of Bollstädt, a distinguished German scholar of the 13th century: b. 1200; d. 1280. He studied at Padua, became a monk of the Dominican order, teaching in the schools of Hildesheim, Ratisbon, and Cologne, where Thomas Aquinas became his pupil. In 1245 he went to Paris and publicly expounded the doctrines of Aristotle. It was through his teaching that the philosophy of the Stagyrite became predominant in the Middle Ages. He became a rector in the school of Cologne in 1249; in 1254 he was made provincial of his order in Germany; and in 1260 he received from Pope Alexander IV. the appointment of Bishop of Ratisbon. In 1263 he retired to his convent at Cologne, where he composed many works, especially commentaries on Aristotle.

Albicore, or Albacore. See TUNNY.

Albigenses, a religious sect, coming first into prominence in the 12th century, and taking its name from Albi, their principal stronghold. What their doctrines were has not been determined, as no formal statement of them was ever drawn up. It appears that the Albigenses held beliefs similar to those of the Patarins in Italy, the Bulgarians in France, and other similar sects. They styled themselves Cathari the Pure and traced their doctrines to the Manichean sect known as Paulicians, that settled in Bulgaria, whence their tenets spread to France.

They taught the doctrine of the Manicheans, that there are two opposing creative principles, one good, the other evil; the invisible word proceeding from the former, the body and all material things from the latter. «Their teachers assumed a great simplicity of manners, dress, and mode of life. They inveighed against the vices and worldliness of the clergy, and there was sufficient truth in their censures to dispose their hearers to believe what they advanced and reject what they decried. They also rejected the Old Testament, said that infant baptism was useless, and denied marriage to the 'perfect' as they called their more austere members.» (Addis and Arnold's 'Catholic Dictionary'.)

On the other hand the license permitted to the imperfect gave rise to so much fanaticism and grave social and moral disorders as to threaten the destruction of Christian civilization in the heart of France. They had increased very much toward the close of the 12th century in the south of France, about Toulouse and Albi, and in Raymond, Count of Toulouse, they found a patron and protector. Innocent III., after trying in vain to reform the abuses prevalent among them, was so incensed by the assassination of the papal legate, Peter of Castelnau, in 1208, that he proclaimed a crusade against them, and was supported by the king of France.

An army was accordingly collected, large numbers of those composing it being mere mercenaries and adventurers brought together by the hope of plunder rather than by zeal for the Catholic faith. The chief leader was Simon de Montfort, father of the well-known Earl of Leicester. Raymond's territories were ravaged, and in 1209 the crusaders took Beziers by storm, and put a number of the inhabitants to the sword. Simon de Montfort was equally severe toward other places in the territory of Raymond and his allies, of whom Roger, nephew of Raymond, died in a prison and Peter I., king of Aragon, in battle. The lands taken were presented, as a reward for his services, to Simon de Montfort, who, however, was killed at the siege of Toulouse in 1218. When Innocent III. heard of the cruelties of the invading armies he recalled his legate Milo for his weakness in not restraining Simon and restored to Raymond the captured territory. Soon after, however, Raymond once more espoused the cause of the Albigenses. He died in 1222, under excommunication, and his son, Raymond VII., was obliged to defend his inheritance against the legates and Louis VIII. of France, who fell in 1226 in a campaign against the Albigenses. After thousands had fallen on

both sides a peace was made in 1229 by the terms of which Raymond was released from the penalties in consideration of a large tribute. He ceded Narbonne, with several estates, to Louis IX., and made his son-in-law, a brother of Louis, heir of his other lands.

Albinism, a condition in which there is a congenital absence of pigment in the hair, eye, and skin. Animals so affected are albinos. Albinism is also present in the flowers of many if not all plants, white flowers occurring among those of other color on the same plant. Albinos have been known among all races and all peoples, hence neither climate nor race are its causative factors. Rare in many races, it occurs frequently in others, as for instance in the Zuni and other tribes of Arizona. The most widely accepted theory is that the condition is due to an arrest of development of the pigment layers in the embryo. Affections of the eye are the most important disagreeable features for albinos.

Albion, the earliest name by which the island of Great Britain was known, employed by Aristotle, and in poetry still used for Great Britain. The Greeks and Romans probably received the name from the Gauls, in whose language it would mean mountain-land or white-land, from the Celtic *alp, alb*, said to mean high or white (whence also Alps), the latter name being given to it in reference to the chalky cliffs on the coasts.

Albion, Mich., city in Calhoun County, situated on Kalamazoo River, the Lake Shore & M. S. and the Michigan C. R.R.'s, 28 miles south of Lansing. It has three banks, with a combined capital of $185,000; six churches and good schools. Albion College (q.v.) is located here. There are manufactures of doors and sashes, tools, harness and carriages. It is governed by common council of eight members, elected yearly. First settled in 1831, became a borough in 1855, incorporated in 1885. Pop. (1900) 4,519.

W. S. Kennedy,
Editor 'Recorder.'

Albion, N. Y., the county-seat of Orleans County, on the New York Central R.R. and the Erie Canal, about 43 m. northeast of Buffalo. It has two banks, public parks, a free library, several schools and churches, and 5 newspapers. The House of Refuge for Women is located here. The most important manufactures are mowing-machines, carriages, shoes, and plows. There are large stone quarries here and several fruit canneries. The city is lighted by electricity. The affairs of the community are administered by a mayor and board of trustees. Albion was first settled in 1812, incorporated 1828. Pop. (1900) 5,749.

Albion, New. See New Albion.

Albion College, a coeducational institution in Albion, Mich., organized under the auspices of the Methodist Episcopal Church. Professors and instructors, 25; students, 454; volumes in the library, 15,000; grounds and buildings valued at $80,000; productive funds, $228,000; income, $29,000; graduates, 986.

Albite, an important member of the feldspar group of minerals. It stands at one end of the albite-anorthite series of triclinic feldspars (see Feldspar Group). It is a sodium-aluminum silicate, $Na\ Al\ Si_3O_8$, and is often called «soda feldspar.» It has perfect basal cleavage and also cleaves easily parallel to the brachypinacoid. It is brittle, breaking with an uneven to conchoidal fracture. Its hardness is 6 to 6.5, and specific gravity about 2.63. Its usual color is white, whence its name (from «albus,» white), but it is occasionally gray or tinted with blue, green or red. The variety peristerite shows a delicate blue irridescence, similar to the «change of colors» of moonstone, which is also sometimes a variety of albite. Cleavelandite is a common lamellar variety, named in honor of the eminent mineralogist, Dr. P. Cleaveland, who died in 1858. Albite crystals present a great variety of forms, some of the simpler of which are quite similar to those of the monoclinic orthoclase, with which albite is often associated in parallel growths and intergrowths such as perthite. Twinning is even more common in albite than in orthoclase, and their analogy is shown by the occurrence of Carlsbad, Baveno and Manebach twins. Several other laws of twinning are, however, followed by albite, notably those known as the «albite law» and the «pericline law.» Both of these types are very common and often manifest themselves by the polysynthetic twinning lamellæ which are so characteristic of the plagioclase feldspars. Albite often occurs in tabular crystals and embedded masses in which this twinning is revealed by striations on the basal plane. Probably the most striking occurrence of albite is at Amelia, Va., this locality producing large groups of tabular crystals, each over a foot in length. It usually occurs in granite or gneiss, and less frequently in the crystalline schists. It is found but rarely in volcanic rocks and in limestones. Many of the most highly prized gem minerals, such as topaz, beryl and tourmaline occur in albitic granite, while albite is often a guide mineral to columbite, allanite and other rarer minerals. It is also an essential constituent of dioryte. There are many noteworthy localities in Switzerland, the Tyrol, Cornwall and elsewhere in Europe, while it abounds throughout the Atlantic Coast States, and is found in especially attractive specimens on amazonstone in Colorado.

Albret, Jeanne d', Queen of Navarre, daughter of Henry II. of Navarre and Margaret of Valois (sister of Francis I. of France), was the mother of Henry IV. of France, and a zealous supporter of the reformed religion, which she established in her kingdom. She was b. in 1528; d. 1572. She married Antoine de Bourbon in 1548, succeeded her father on the throne of Navarre and Béarn in 1555, reigned in conjunction with her husband till his death in 1562, and afterward alone.

Albright, Jacob, American minister of the Methodist Church: b. near Pottstown, Pa., 1 May 1759; d. 1808. His work lay among the Germans of Pennsylvania. Becoming impressed with the decline of religious life and of the doctrines and morals of the surrounding churches, he began a work of reform in 1790. He traveled about the country at his own expense, preaching his mission, until he founded in 1800 the Evangelical Association (q.v.), often known as «Albrights.»

Albufera, a lake about 9 miles square near Valencia, Spain, supposed to have been excavated by the Moors. It is separated from the sea

by a strip of land. The revenues from the fisheries of the lake belonged at one time to the Duke of Wellington.

Albula, a Swiss river in the Canton Grisons, an affluent of the Rhine, 29 m. in length, in which distance it falls over 4,500 feet.

Albula Pass, at the head of the Albula Valley, about 7,600 ft. above the sea. In this pass is the most direct road from the valley of the Inn to the valley of the Hiter-Rhein. A railroad now runs through it.

Album, among the Romans, a board or tablet on which official notices, such as the prætor's edicts, lists of the members of public bodies, etc., were written, and which was put up in some public place to be seen by all. It was so called either because it was of a white material (*albus,* white) or a material whitened, or because the writing on it was in white. Album is a name now generally given to a blank book for the reception of pieces of poetry, autographs, engravings, photographs, etc.

Albu'men, or **Albumin** (L., from *albus,* white), a substance, or rather group of substances, so named from the Latin for the white of an egg, which is one of its most abundant known forms. It may be taken as the type of the protein compounds or the nitrogenous class of food stuffs. One variety enters largely into the composition of the animal fluids and solids, is coagulable by heat at and above 160°, and is composed of carbon, hydrogen, nitrogen, and oxygen, with a little sulphur. It abounds in the serum of the blood, the vitreous and crystalline humors of the eye, the fluid of dropsy, the substance called coagulable lymph, in nutritive matters, the juice of flesh, etc. The blood contains about 7 per cent of albumen. When albumen coagulates in any fluid it readily incloses any substances that may be suspended in the fluid. Hence it is used to clarify syrupy liquors. In cookery white of eggs is employed for clarifying, but in large operations like sugar-refining the serum of blood is used. From its being coagulable by various salts, and especially by corrosive sublimate, with which it forms an insoluble compound, white of egg is a convenient antidote in cases of poisoning by that substance. With lime it forms a cement to mend broken ware.

In Botany.—A substance interposed between the embryo and the testa of many plants. It is sometimes soft and fleshy, and at other times hard. It varies greatly in amount in those plants in which it is present, being particularly large in some endogens, such as the cocoanut, in which it constitutes the eatable part of the fruit.

In Photography.—A process by which albumen is used instead of collodion to coat glass or paper. A method of doing this in the case of glass was published by M. Nièpce de Saint Victor in the 'Technologist' for 1848. It was subsequently improved by M. le Gray. The foreign transparent stereoscopic views were at one time obtained by the use of albumen in the way now described.

Albuminoid. See PROTEIDS.

Albuminuria, a condition characterized by the presence of albumen in the urine, irrespective of any organic disease of the kidney. Thus there may be a functional or physiological albuminuria, following excessive exercise, such as bicycling; febrile albuminuria as a result of fever, being especially common in malaria, pneumonia, diphtheria, and typhoid; hemic albuminuria accompanying blood diseases, lukemia, anæmia, poisoning by lead and mercury, syphilis, etc. Any of these albuminurias may result in chronic disease. See KIDNEYS.

Albunol, a town of southern Spain, in the province of Granada, near the Mediterranean, on which it has a harbor, some 35 m. to the south of the city of Granada. Pop. 9,400.

Albuquerque, Affonso d', al'bö-kärk'e, «the Great,» Viceroy of the Indies: b. near Lisbon, 1453; d. in Goa, 16 Dec. 1515. The Portuguese had discovered and subjugated a great part of the western coast of Africa, and were beginning to extend their dominion over the seas and the people of India. Albuquerque, being appointed viceroy of these new possessions, with a fleet and some troops landed on the Malabar coast in 1503; conquered Goa, which he made the seat of the Portuguese government and the centre of its Asiatic commerce; and afterward Ceylon, the Sunda Isles, the Peninsula of Malacca, and the island of Ormuz at the entrance of the Persian Gulf. When the king of Persia sent for the tribute which the princes of this island had formerly rendered to him, Albuquerque presented bullets and swords to the ambassador, saying: «This is the coin in which Portugal pays her tribute.» He made the Portuguese name profoundly respected among the princes and people of the East; and many of them, especially the kings of Siam and Pegu, sought his alliance and protection. He maintained strict military discipline, was active, far-seeing, wise, humane, and equitable, respected and feared by his neighbors while beloved by his subjects. His virtues made such an impression on the Indian peoples that, long after his death, they resorted to his grave to implore his protection against the misgovernment of his successors. Yet he did not escape the envy of courtiers and the suspicions of his king, who appointed Soarez, a personal enemy of Albuquerque, to supersede him as viceroy. This news reached him just as he was leaving Ormuz, and gave a severe shock to his shattered health and he died a few days later.

Albuquerque, al'be-kerk, N. M., town and county-seat of Bernalillo co.; situated on the Rio Grande and the Atchison, T. & S. F. and the Santa Fé Pacific R.R.'s: 75 m. S.W. of Santa Fé. It has an elevation of 5,000 feet above sea-level; is an ancient and interesting settlement, divided into the Old and New towns; and is the seat of the University of New Mexico and of a government school for Indians. The town is located in a rich gold, silver, iron, and coal mining region, and has also an extensive trade in hides, grain, wool, and wine. There are a number of railroad shops, a foundry and machine works, a national bank (capital about $150,000), and large trading and jobbing interests. Pop. (1900) 6,238.

Albur'num, the soft white substance which, in trees, is found between the liber or inner bark and the wood, and, in progress of time acquiring solidity, becomes itself the wood. A new layer of wood, or rather of alburnum, is added annually to the tree in every part just under the bark.

Alcala, name of seven cities in Spain, but by far the most important in Spanish history is Alcala de Henares, province of Toledo. Cardinal Ximines began the first building of the University of Alcala in 1500. Francis I., in 1517, declared that the cardinal had done for Spain what it had taken many kings to do for France. It was in Alcala that the famous Complutensian Polyglot Bible was brought forth.

Alchemist, The, a satirical comedy by Ben Jonson; probably his greatest work. It was played in 1610, and published in 1612. Its subject is the paramount folly of the time, the search for the philosopher's stone. The Alchemist is the quack Subtle, who, previous to exposure deludes the credulous characters of the play, the chief of whom is Sir Epicure Mammon.

Alchemy, or **Alchymy,** the art which in former times occupied the place of and paved the way for the modern science of chemistry (as astrology did for astronomy), but whose aims were not scientific, being confined solely to the discovery of the means of indefinitely prolonging human life, and of transmuting the baser metals into gold and silver. Probably the ancient nations, in their first attempts to melt metals, observing that the composition of different metals produced masses of a color unlike either — for instance, that a mixture like gold resulted from the melting together of copper and zinc — arrived at the conclusion that one metal could be changed into another. At an early period the desire of gold and silver grew strong as luxury increased, and men indulged the hope of obtaining these rarer metals from the more common. At the same time the love of life led to the idea of finding a remedy against all diseases, a means of lessening the infirmities of age, of renewing youth, and repelling death. The hope of realizing these ideas prompted the efforts of several men, who taught their doctrines through mystical images and symbols. To transmute metals they thought it necessary to find a substitute which, containing the original principle of all matter, should possess the power of dissolving all into its elements. This general solvent or *menstruum universale*, which at the same time was to possess the power of removing all the seeds of disease out of the human body and renewing life, was called the philosopher's stone, *lapis philosophorum*, and its pretended possessors adepts. The more obscure the ideas which the alchemists themselves had of the appearances occurring in their experiments, the more they endeavored to express themselves in symbolical language. Afterward they retained this phraseology to conceal their secrets from the uninitiated. In Egypt Hermes Trismegistus was said to have left behind him many books of chemical, magical, and alchemical learning. These, however, are of a later date. (See HERMES TRISMEGISTUS.) After him chemistry and alchemy received the name of the hermetic art. It is certain that the ancient Egyptians possessed considerable chemical and metallurgical knowledge, although the origin of alchemy cannot with certainty be attributed to them. Several Grecians became acquainted with the writings of the Egyptians, and initiated in their chemical knowledge. The fondness for magic, and for alchemy more particularly, spread afterward among the Romans also. When true science was persecuted under the Roman tyrants, superstition and false philosophy flourished the more. The prodigality of the Romans excited the desire for gold, and led them to pursue the art which promised it instantaneously and abundantly. Caligula made experiments with a view of obtaining gold from orpiment. On the other hand, Diocletian ordered all books to be burned that taught to manufacture gold and silver by alchemy. At that time many books on alchemy were written, and falsely inscribed with the names of renowned men of antiquity. Thus a number of writings were ascribed to Democritus, and more to Hermes, which were written by Egyptian monks and hermits, and which, as the Tabula Smaragdina, taught in allegories, with mystical and symbolical figures, the way to discover the philosopher's stone. At a later period chemistry and alchemy were cultivated among the Arabians. In the 8th century the first chemist, commonly said to be Geber, flourished among them, in whose works rules are given for preparing quicksilver and other metals. In the Middle Ages the monks devoted themselves to alchemy, although they were afterward prohibited from studying it by the popes. But there was one even among these, John XXII., who was fond of alchemy. Raymond Lully, or Lullius, was one of the most famous alchemists in the 13th and 14th centuries. A story is told of him that during his stay in London he changed for King Edward I. a mass of 50,000 pounds of quicksilver into gold, of which the first rose-nobles were coined. The study of alchemy was prohibited at Venice in 1488. Paracelsus, who was highly celebrated about 1525, belongs to the renowned alchemists, as do Roger Bacon, Basilius Valentinus, and many others. When, however, more rational principles of chemistry and philosophy began to be diffused and to shed light on chemical phenomena, the rage for alchemy gradually decreased, though many persons, including some nobles, still remained devoted to it. Alchemy has, however, afforded some service to chemistry, and even to medicine. Chemistry was first carefully studied by the alchemists, to whose labor and patience we are indebted for several useful discoveries, for example, various preparations of quicksilver, kermes, etc.

It is still impossible to assert anything with certainty about the transmutation of metals. Modern chemistry, indeed, places metals in the class of elements, and denies the possibility of changing an inferior metal into gold. Most of the accounts of such transmutation rest on fraud or delusion, although some of them are accompanied with circumstances and testimony which render them probable. By means of the galvanic battery even the alkalies have been discovered to have a metallic base. The possibility of obtaining metal from other substances which contain the ingredients composing it, and of changing one metal into another, or rather of refining it, must therefore be left undecided. Nor are all alchemists to be considered impostors. Many have labored, under the conviction of the possibility of obtaining their object, with indefatigable patience and purity of heart (which is earnestly recommended by sound alchemists as the principal requisite for the success of their labors). Designing men, however, have often

used alchemy as a mask for their covetousness, and as a means of defrauding silly people of their money. Many persons even in our days, destitute of sound chemical knowledge, have been led by old books on alchemy, which they did not understand, into long, expensive, and fruitless labors. Hitherto chemistry has not succeeded in unfolding the principles by which metals are formed, the laws of their production, their growth and refinement, and in aiding or imitating this process of nature; consequently the labor of the alchemist is but a groping in the dark.

Alciati, Andrea, Italian jurist and poet: b. Milan, 8 May 1492; d. Pavia, 12 Jan. 1550. For many years an advocate in Milan, he treated the objects of legal science to keen criticism, and was founder of the so-called « elegant» school of law. He also wrote several antiquarian and historical essays, but his most popular work was the ‹ Emblems › (Milan 1522), epigrammatic poems on his contemporaries' virtues and vices. Of the numerous editions of this work several are chiefly sought on account of their wood-engravings. Editions of his ‹ Complete Works › in Latin: 4 vols. Basle, 1546–9; 6 vols. Lyons, 1560–1; 4 vols. Frankfort, 1617. Cf. C. Mignault's ‹ Life of Alciati › (Milan, 1584).

Alcibiades, son of Cleinias, an Athenian of high family: b. in Athens 450 B.C.; d. 404 B.C. His father, who died a few years after his birth, had greatly distinguished himself in the Persian wars, and had taken a prominent part in the expulsion of the Peisistratidæ. Alcibiades was a relation of Pericles, who was his joint guardian along with Ariphron. He was remarkable in youth for the beauty of his person, the dissoluteness of his manners, the determination of his character, and the greatness of his abilities. He came under the influence of Socrates, who tried to lead him into the paths of virtue; but though their friendship was strengthened by mutual obligations, each having saved the other in battle, the passions of Alcibiades were too strong for advice, and little permanent effect was produced on his character. He acquired great popularity by his liberality in providing for the amusements of the people, and although guilty of many violent, extravagant, and audacious acts, he had, after the death of Cleon, a political ascendency which left him no rival but Nicias. Both at first cultivated alliance with Sparta, to which Alcibiades had a hereditary partiality, but the Spartans trusting more to Nicias, he was offended, and induced the Athenians to break with Sparta and ally themselves with Argos, Elis, and Mantineia (in the Peloponnesian war). In 419 he was chosen *strategos,* and led a small army into the Peloponnesus with which some important operations were effected. In 415 he advocated the Sicilian war, and was chosen one of the leaders of the expedition appointed to conduct it; but before it sailed he was charged with profaning and divulging the Eleusinian mysteries, and mutilating the busts of Hermes which were set up in public all through Athens. He was permitted to take his place in the expedition, but was recalled before his plans could be accomplished. He made his escape and went to Sparta, where he was well received. He divulged the plans of the Athenians, and assisted the Spartans to defeat them. Sentence of death and confiscation was pronounced against him at Athens, and he was cursed by the ministers of religion. He induced the Athenian dependencies of Athens to revolt, and made alliance with Tissaphernes, a Persian satrap. Soon after he abandoned Sparta and took refuge with the Persian, ingratiating himself by his affectation of Persian manners as he had previously done at Sparta by a similar affectation of Spartan simplicity. He now began to intrigue for his return to Athens, offering to bring Tissaphernes over to the Athenian alliance. His intrigue led to the establishment of an oligarchy (the Four Hundred), but they did not recall him. The fleet, however, which was stationed at Samos declared in favor of a democracy and recalled him. The revolution was effected at Athens without the return of the armament, and the banishment of Alcibiades was cancelled. He remained abroad, however, for some years in command of the Athenian forces, gained several victories, and took Chalcedon and Byzantium. In 407 B.C. he returned to Athens, where all proceedings against him were cancelled, but in 406, the fleet which he commanded having suffered a severe defeat, he was deprived of his command. He retired to the Thracian Chersonesus, where he made war with mercenaries on the Thracian tribes. On the establishment of the Thirty at Athens a decree of banishment was passed against him. He took refuge with Pharnabazus, a Persian satrap, and was about to proceed to the court of Persia when he was assassinated, probably through private revenge.

Alcinous, said to have been a king of the Phæacians, in the island now called Corfu. See ULYSSES.

Alciphron, al'si-frŏn, a Greek rhetorician who flourished in the 2d century of the Christian era and attained celebrity through his series of more than a hundred imaginary letters purporting to be written by the very dregs of the Athenian population, including courtesans and petty rogues. Their importance in literature is due almost wholly to the insight they afford into the social conditions and manners and morals of the day. The letters from the courtesans (*hetairai*) are based upon incidents in Menander's lost plays, and the new Attic comedy was likewise drawn upon for material.

Alciphron, or **The Minute Philosopher.** See BERKELEY, BISHOP.

Alcira, a well-built and strongly-fortified town of Spain, in the province of Valencia, on an island encircled by two arms of the river Jucar, some 25 m. from Valencia. It was founded by the Carthaginians. Pop. 20,000.

Alcmæon, alk-mē'on, a son of Amphiaraus and Eriphyle, was one of the heroes who took part in the successful expedition of the Epigoni against Thebes. He was charged by his father to put his mother to death in revenge for her having urged her husband to take part in an expedition in which his foresight showed him he should perish. She had been gained over to urge this fatal course by a gift from Polynices of the fatal necklace of Harmonia. The matricide brought upon Alcmæon madness and the horror of being haunted by the Furies, but at Psophis he was purified by Phegeus, whose daughter he married, giving her the fatal

present. But the land became barren in consequence of his presence, and he fled to the mouth of the river Achelous, the god of which gave him his daughter Callirrhoë in marriage. His new wife longed for the fatal necklace, and sent her husband to Psophis to procure it under the pretence of dedicating it at Delhi; but Phegeus, learning for whom it was really intended, caused his sons to murder the ill-fated Alcmæon.

Alcman, one of the earliest and greatest of Greek lyric poets, belonging to the 7th century B.C. He is supposed to have been a native of Lydia, and to have been taken as a slave to Sparta. Only small fragments of his odes remain. He used the broad, homely Doric dialect. His poems were love ditties, hymns, pæans, processional chants, etc.

Alcmene, or **Alkmene,** alk-mē'nē, in Greek mythology, the daughter of Anaxo and Electryon, king of Mycenæ. She became the mother of Hercules through Zeus, who took the form of her husband Amphitryon. Finally Zeus bade Hermes guide her to the Islands of the Blest, where she was happily united with Rhadamanthus.

Alco, a small variety of dog, with a small head and large pendulous ears, found wild in Mexico and Peru, and also domesticated.

Alcobaça, a small town of Portugal, in Estremadura, 50 m. N. of Lisbon, at the junction of the Alcoa and Baça; is celebrated for a magnificent Cistercian monastery, the richest in the kingdom. It was founded in 1148 by Don Alphonso I. The buildings include an early Gothic church, containing the tombs of some of the Portuguese kings. The library is said to possess more than 25,000 volumes. Parts of the buildings are used for barracks.

Alcock, Sir Rutherford, diplomat: b. Ealing, 1809; d. London, 2 Nov. 1897. Educated as a physician, he served as surgeon with British troops in Spain and Portugal 1832–6; and was appointed consul at Fuchow 1844. On the way his services were requisitioned at Amoy, where, with Sir Harry Parkes, he succeeded in convincing the Chinese officials that treaty agreements were to be respected and kept. Transferred to Shanghai he showed courage and determination by proclaiming that English ships would pay no duties, and that 1,400 grain junks then waiting to sail would not be allowed to go until the murderers of some missionaries were seized and punished. Though only one British sloop of war was in the harbor at the time, his bold attitude succeeded. He was appointed first consul-general in Japan 1858, and created K. C. B. 1862. As minister at Peking (1865) he conducted many difficult negotiations with tact and success. Retiring in 1871, he devoted himself to medical charities, promotion of geographical studies, and the furtherance of a knowledge of Japanese art. Works: 'Medical History and Statistics of the British Legion in Spain' (1838); 'Japanese Grammar' (1861); 'Capital of the Tycoon' (1863); 'Art and Art Industries in Japan' (1878).

Alcofribas Nasier, pseudonym sometimes used by Rabelais (q.v.).

Al'cohol. (Origin of the word somewhat obscure. According to most authorities it is from the Arabic ***al-koh'l, koh'l*** being the finely-powdered black sulphid of antimony used in the East for painting the eyebrows. First used to signify this powder, it afterward stood for any fine powder obtained by trituration or sublimation; then for any essence or spirit, and lastly for the liquid to which it is now applied. In the latter part of the 16th century spirit dried over powdered carbonate of potash was called *spiritus alcolisatus;* but Kopp suggests that this is a corruption of *spiritus alcalisatus*, signifying spirit that has been treated with alkali, and that alcolized [or alcoholized] spirit was then shortened to alcohol.)

1. *Ethyl Alcohol.*— Unless otherwise qualified, «alcohol» is understood to mean the liquid known to the chemist as «ethyl alcohol,» and to the trade as «grain alcohol,» or «spirits of wine.» It is colorless and inflammable, burning with a flame that is intensely hot but almost non-luminous. Most of the alcohol used in the arts is produced by the fermentation of sugars or starches. A thin paste is made from molasses, finely ground corn or potatoes, or other natural products containing sugars or starches, and a small quantity of malt or other agent containing diastase (q.v.) is added. The mixture is then allowed to stand until the diastase has transformed the starch into dextrose (glucose). Taking the chemical formula of starch as $(C_6H_{10}O_5)_3$ for the sake of illustration, we may have either of the following reactions as the primary effect of the diastase:

$$\underset{\text{Starch}}{(C_6H_{10}O_5)_3} + \underset{\text{Water}}{H_2O} = \underset{\text{Dextrin}}{(C_6H_{10}O_5)_2} + \underset{\text{Dextrose}}{C_6H_{12}O_6}$$

$$\underset{\text{Starch}}{(C_6H_{10}O_5)_3} + \underset{\text{Water}}{2H_2O} = \underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + \underset{\text{Dextrose}}{C_6H_{12}O_6}$$

Neither dextrin nor maltose is directly fermentable, but each slowly becomes further transformed into dextrose, as appears from the following equations:

$$\underset{\text{Dextrin}}{(C_6H_{10}O_5)_2} + \underset{\text{Water}}{2H_2O} = \underset{\text{Dextrose}}{2C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + \underset{\text{Water}}{H_2O} = \underset{\text{Dextrose}}{2C_6H_{12}O_6}$$

The reduction to dextrose (glucose) being now complete, yeast is added, and the temperature is maintained at from 72° to 85° F. Under the influence of the yeast-plant (*Saccharomyces cerevisiæ* or *Torula cerevisiæ*) the dextrose then undergoes fermentation, alcohol and carbon-dioxid being the chief products, according to the equation:

$$\underset{\text{Dextrose}}{C_6H_{12}O_6} = \underset{\text{Alcohol}}{2C_2H_6O} + \underset{\text{Carbon-dioxid}}{2CO_2}$$

(A certain amount of nitrogenous and mineral matter must be present, in addition to the starch and sugar, in order to furnish food for the yeast-plant.) The next step in the process is to distil off the alcohol from the fermented product. This is usually done in a still heated by steam. One or more redistillations may be necessary in order to obtain the alcohol in a satisfactory state of purity and strength. The product of the original fermentation is weak in alcohol, but the subsequent distillations effect a great concentration, since alcohol is far more volatile than water and therefore passes off first. The British Pharmacopœia requires rectified spirits (produced as described above) to

have a specific gravity of 0.838, which is equivalent to 84 per cent of alcohol by weight. The United States Pharmacopœia fixes the specific gravity at 0.820, which corresponds to 91 per cent of alcohol by weight. It is possible to obtain this latter degree of concentration by ordinary distillation; but it is not possible to free the alcohol entirely from water without distilling it with potassium-carbonate, quicklime, calcium-chloride, or some similar substance possessing sufficient affinity for water to prevent the water from passing over. The best way to eliminate the last traces of water is to digest strong alcohol with quicklime for two hours at about 100° F., and then distil, rejecting the first and last portions of the distillate. The product is then subjected to the same treatment a second time, after which it will probably be free from water. Alcohol thus deprived of the last trace of water is termed « absolute » or « anhydrous » alcohol. Its chemical formula is $C_2H_5.OH$, and its specific gravity is 0.80625 at 32° F., and 0.79367 at 59° F. Absolute alcohol boils at 173.1° F., when the barometer stands at 29.92 inches (760 mm.). It freezes at about 200° below zero F., first becoming very viscid. Its low freezing-point has led to its use as a thermometric fluid for the measurement of low temperatures. Its specific heat is variously estimated, but is in the vicinity of 0.61. Absolute alcohol has a powerful affinity for water, and it is therefore used as an astringent, and (for certain purposes) as an antiseptic. When exposed to the air it quickly absorbs a sensible amount of aqueous vapor, and ceases to be « absolute.» According to the experiments of Atwater, the human body is capable of oxidizing about two ounces of it per day, since this amount can be administered without any evidence of alcohol appearing in the excreta. Alcohol mixes with water in all proportions, and is extensively used as a solvent for substances that do not dissolve in water: notably for organic substances and for alkaloids and drugs. When absolute alcohol is mixed with water the volume of the mixture is considerably less than the sum of the volumes of the constituents. The specific gravity of such a mixture therefore cannot be deduced by any simple formula; but it has been found by direct experiment, and tabulated, for all possible mixtures and temperatures. The strength of a given mixture of alcohol and water may be found by observing the specific gravity of the mixture at a definite temperature by means of a hydrometer (q.v.) and then referring to the tables. The greatest contraction of volume observed upon mixing absolute alcohol and water occurs when 49.8 volumes of water are mixed with 53.9 volumes of absolute alcohol, both liquids being at 32° F. The volume of the mixture is then 100, instead of 103.7, as it would be if there were no contraction. Mendeléeff points out that this particular mixture corresponds to a possible compound having the formula $C_2H_6O.3H_2O$; but it has not been conclusively proved that such compound exists. An alcohol containing 49.3 per cent (by weight) of absolute alcohol is known in the arts and for excise purposes as « proof spirit.» This term was originally intended to denote alcohol just strong enough to ignite gunpowder when burned upon it; but it was defined by law in the reign of George III. of England to be spirit « such as shall, at the temperature of 51° F., weigh exactly twelve-thirteenth parts of an equal amount of distilled water » (Watts). At 60° F. proof spirit has a specific gravity of 0.920. A mixture stronger or weaker than this is said to be (respectively) overproof or underproof. Distilled liquors, such as whiskey, brandy, and gin, contain from 40 to 50 per cent of absolute alcohol, wines from 7 to 20, ale and porter from 5 to 7, and beer from 2 to 10. Alcohol coagulates albumen, and, partly for this reason and partly because of its action in arresting the development of micro-organisms, it prevents the putrefaction of dead animal matter. The alkali metals attack absolute alcohol rapidly with the formation of compounds variously known as alcoholates, alcohates, and alcoates, but more definitely and correctly as « ethylates.» Thus alcohol may be regarded as water in which one atom of hydrogen has been replaced by a molecule of the organic radical ethyl, C_2H_5, and, water being H-O-H, the formula for alcohol may be written (C_2H_5)-O-H. An alkali metal, when it combines with alcohol, merely replaces the H at the right of this formula; and sodium ethylate (for example) is therefore (C_2H_5)-O-Na, or simply C_2H_5ONa. The commonest test for alcohol in small quantities consists in warming the suspected liquid (or its distillate) with caustic potash and iodine. If alcohol is present iodoform comes down after a time as a precipitate. In England the use of alcohol in the arts is permitted without the payment of an excise tax, provided the alcohol contains 10 per cent of methyl alcohol (wood spirit). Alcohol so treated is known as « methylated spirit »; it is unfit for drinking, and the methyl alcohol that it contains cannot be readily removed. Alcohol can be prepared directly from its elements as follows: Acetylene (q.v.), C_2H_2, will combine directly with hydrogen to form olefiant gas, C_2H_4; concentrated sulphuric acid will absorb olefiant gas with the formation of hydrogen-ethyl-sulphate, $C_2H_5.HSO_4$; and if the product so obtained is diluted with water and boiled, alcohol is formed in accordance with the equation:

$$C_2H_5.HSO_4 + H_2O = H_2SO_4 + C_2H_5.OH.$$

This process is of considerable theoretic interest, and is said to be in commercial use in Russia. Until carbide of calcium (from which acetylene is prepared) can be had more cheaply, however, it can hardly be successfully used in the United States.

2. *Wood Alcohol, or Methyl Alcohol.*— A colorless, inflammable liquid, strongly resembling ethyl alcohol in its general properties. It burns with a flame resembling that of grain alcohol, but with sensibly less evolution of heat. It is far cheaper than grain alcohol, because there is no excise tax upon it; in many uses it may be substituted for grain alcohol with success, its solvent powers being very similar. It cannot be used internally, however, as it is of a poisonous nature, and has a peculiar selective action upon the optic nerve, in which it often induces a condition of permanent atrophy with consequent total blindness. Methyl alcohol is obtained by the dry distillation of wood. The process, as carried out in New York State, is substantially as follows: Hardwood is cut into cordwood size and allowed to season thoroughly,

two-year-old wood being dry enough to yield excellent results. Beech, maple, and birch are most commonly used, birch being the poorest of the three, because it yields a larger proportion of objectionable tarry matter. The seasoned wood is placed in retorts of cast iron or sheet steel, which are cylindrical in general shape, and large enough to hold rather more than half a cord each. A slow fire is then built under the retorts, its intensity being gradually increased as the distillation progresses, and regulated so that at the end of from 12 to 18 hours nothing remains in the retort but charcoal. The distillate is passed through a condenser, by which a portion is condensed into a watery fluid, while another and very considerable portion passes through in the form of a permanent, non-condensable gas. The non-condensable part consists largely of marsh gas, hydrogen, carbon-dioxid, and carbon-monoxid, together with smaller amounts of acetylene and numerous other substances. No attempt is made to utilize this portion of the product except as fuel. The portion that condenses consists largely of acetic acid and methyl alcohol, together with acetate of methyl and acetone, and a considerable quantity of tarry matter. The condensed distillate is passed into settling-tanks, where it is allowed to remain until the greater part of the tarry matter has subsided. The lighter part is then drawn off and saturated with slaked lime to fix the acetic acid. A second distillation expels the methyl alcohol, which is recovered by means of a condenser and shipped to the refiners in iron tanks, being known to the trade in this form as « wood spirit.» The acetate of lime remaining behind is then recovered by evaporation and spread out upon a heated floor to dry.

Acetate of lime, as it comes from the alcohol manufacturer, is brown in color, from the tarry impurities that it contains. It is used in the manufacture of acetic acid and the various acetates (notably those of iron and aluminum) that are used in dyeing and in printing upon cloth. The impure methyl alcohol, or « wood spirit,» that is shipped from the factory to the refiner, usually contains 80 per cent of alcohol and 20 per cent of water. The yield of spirit of this strength varies greatly, according to the skill and care exercised by the manufacturer; but in the best plants it may be taken at from eight to nine gallons per cord of good wood. Crude wood spirit contains considerable empyreumatic matter as well as acetone, acetate of methyl, and acetate of ammonia. Pure methyl alcohol may be prepared by saturating the crude spirit with fused calcium chloride ($CaCl_2$) and heating on a water-bath. Methyl alcohol combines with calcium chloride, under these conditions forming a compound which can be readily purified, and from which the alcohol can again be recovered by distilling with water. A final distillation over quicklime will give the alcohol in its anhydrous or « absolute » state. Pure methyl alcohol, free from water, has a specific gravity at 32° F. of 0.8101. Its chemical formula is $CH_3.OH$; it is the hydrate of the organic radical « methyl » (CH_3), being analogous in this respect to ethyl alcohol, which is the hydrate of the organic radical « ethyl » (C_2H_5). It boils at about 151° F. under ordinary atmospheric pressure.

3. *Alcohol.*— In organic chemistry, a member of a numerous class of compounds consisting of carbon, hydrogen, and oxygen, and derived from hydrocarbons containing an even number of hydrogen atoms by the substitution of one or more hydroxyl molecules (HO) for an equal number of hydrogen atoms. The alcohols, as thus defined, include the two substances described above, and also many others (such as glycerin) whose properties at first sight appear to be radically different from those of either ethyl or methyl alcohol. Alcohols are classified as monohydric, dihydric, trihydric, tetrahydric, pentahydric, and hexahydric, according as they contain one, two, three, four, five, or six molecules of hydroxyl (OH). Thus ethyl alcohol, C_2H_5OH, is monohydric, while glycerin, $C_3H_5.(OH)_3$, is trihydric. In the present article only the monohydric alcohols will be considered. These are divisible into five general series as follows: (*a*) Those having the general formula $C_nH_{2n+1}.OH$; they are derived from the paraffins, C_nH_{2n+2}, by the substitution of one molecule of OH for one atom of hydrogen, and are known as the « fatty alcohols.» (*b*) Those having the formula $C_nH_{2n-1}.OH$. Allyl alcohol is the most familiar member of this series. Its formula is $C_3H_5.OH$. (*c*) Those having the general formula $C_nH_{2n-3}.OH$. No familiar example can be given. (*d*) Those having the general formula $C_nH_{2n-7}.OH$. This series is derived from the aromatic series of hydrocarbons, just as the first series given above is derived from the paraffins. Thus, when hydrogen peroxid, H_2O_2, acts upon benzene, C_6H_6, we have $C_6H_6 + H_2O_2 = H_2O + C_6H_5.OH$, the last expression in this equation being the formula of phenyl alcohol, or (as it is more familiarly known) carbolic acid. (*e*) Those having the general formula $C_nH_{2n-9}.OH$. Cholesterin belongs to this series. It will be evident that the complete discussion of even the monohydric alcohols would be impossible in the present place; hence in what follows attention will be confined to the fatty or paraffin series of monohydric alcohols, having the general formula $C_nH_{2n+1}.OH$. No less than 17 distinct members of this series are known, the first five, when they are arranged in order according to the number of carbon atoms they contain, being:

Methyl alcohol, $CH_3.OH$.
Ethyl alcohol, $C_2H_5.OH$.
Propyl alcohol, $C_3H_7.OH$.
Butyl alcohol, $C_4H_9.OH$.
Amyl alcohol, $C_5H_{11}.OH$.

The first two members of this series do not admit of any isomeric modifications; but the third member admits of one such modification, and the following members admit of more than one. For example, propane has the formula $CH_3.CH_2.CH_3$, and an alcohol may be formed by substituting OH for any one of the H atoms in this formula. If a hydrogen atom at the end of the formula be replaced in this way, we shall obtain the same result whether the substitution be made at the right-hand end or the left; that much is evident from the symmetry of the formula. But if one of the hydrogen atoms in the central CH_2 be so replaced, the alcohol thus formed may differ from the one previously obtained by an end substitution; and in fact ex-

periment shows that two different alcohols do actually exist, both having the same formula C_3H_7OH. These are distinguished as «primary» and «secondary» respectively. In general, an alcohol is called «primary» if the carbon atom to which the OH is attached is itself attached to only one other carbon atom; it is «secondary» if the carbon atom to which the OH is attached is itself attached to two other carbon atoms; and it is «tertiary» if this carbon atom is attached to three other carbon atoms. If it is admitted that the quantivalence of carbon is never greater than four, it follows that no carbon atom can be attached to more than three other carbon atoms; hence every alcohol in the class under consideration must be either primary, secondary, or tertiary. The various radicals with which hydroxyl (OH) is combined in the alcohols are collectively called alkyls. Thus CH_3 (methyl), C_2H_5 (ethyl), and C_3H_7 (propyl) are all «alkyls,» and an alcohol may be briefly described as the hydrate of an alkyl. Other alkyl compounds are also known. For example, hydrochloric, hydrobromic, hydriodic, or hydrofluoric acid, when allowed to act upon an alkyl hydrate, yields the chloride, bromide, iodide, or fluoride of that alkyl. Thus: $CH_3.OH + HCl = CH_3.Cl + H_2O$; and $C_3H_7.OH + HI = C_3H_7.I + H_2O$. $CH_3.Cl$ is «methyl chloride,» and $C_3H_7.I$ is «propyl iodide.» The oxids of alkyls are called «simple ethers.» (See ETHER.) For example, $(C_2H_5)_2.O$ is ethyl oxid (or ether), often erroneously called «sulphuric ether» from the fact that sulphuric acid is used in preparing it. By the action of various acids upon alkyl hydrates (or alcohols), salts of these alkyls, entirely analogous to the metallic salts, are obtained. Thus acetic acid and ethyl alcohol react according to the equation:

$$C_2H_5.OH + CH_3.COOH = CH_3.COO(C_2H_5) + H_2O.$$

Ethyl hydrate	Acetic acid	Ethyl acetate	Water

This reaction is entirely analogous to the following familiar one relating to potassium:

$$K.OH + CH_3.COOH = CH_3.COOK + H_2O.$$

Potassium hydrate	Acetic acid	Potassium acetate	Water

See ESTERS. A. D. RISTEEN, Ph.D.,
Editorial Staff, ‹Encyclopedia Americana.›

Alcoholism, a term applied to the symptoms produced by poisoning with ethyl alcohol (see ALCOHOL). Alcoholism may be *acute, subacute* or *chronic,* and in order to understand its phases a brief review of the more important features of the physiological action of alcohol is necessary. Locally alcohol is an irritant, and induces congestion and increased cellular activity. There appears to be some foundation for the popular view that taken before a meal alcohol increases the appetite and digestive power, for although in any marked quantity it greatly reduces or altogether inhibits the action of the digestive ferments it is probable that the increased amount of gastric juice secreted under the influence of small amounts more than makes up for this effect. Some authorities maintain that while the stimulant remains in the stomach digestion is retarded, but that after absorption of the alcohol the process advances more rapidly than would otherwise have been the case. The most important effect of the administration of alcohol is manifested by the nervous system. There is still some difference of opinion in this regard, some observers claiming that in small amounts it acts as a stimulant, whereas others assert that the apparent increase in intellectual activity is not real but is dependent on depression of the higher centres whereby the normal self control and reserve are cast off and the lower centres are allowed to act without restraint. Experiments have shown that tasks like the addition of columns of figures or reading series of disconnected syllables were less well performed when the person had taken moderate amounts of alcohol, though he usually felt increased self-confidence and was convinced that the actually inferior work he was doing was especially good. It is in this way that alcohol aids the after dinner speaker, who is by moderate amounts of wine relieved of diffidence or embarrassment and enabled to speak with a fluency never at his command under ordinary conditions. It is probable that the capacity for muscular work also is only apparently augmented by alcohol, the slight increase in efficiency at the start being neutralized by the earlier onset of fatigue. According to modern observers alcohol has but little direct effect on the circulation, though there is some change in the distribution of the blood through dilatation of the peripheral vessels. Respiration is little if at all affected. The question of whether or not alcohol is a food has elicited much controversy, but the experiments of Atwater, Neumann, and others show beyond doubt that a certain amount of alcohol can be completely burnt in the body and serve as a source of heat and energy. In this way a saving of other food stuffs is affected, and in this sense alcohol is undoubtedly a food. The view upheld by some of the older authors that alcohol has the power of lessening the oxidation of the tissues is, however, unfounded. The modern tendency is to regard alcohol not as a physiological stimulant but as a universal depressant. From the above it might be inferred that alcohol does not possess the traditional value ascribed to it in medicine, and to some extent this is true. On the other hand, there are many legitimate indications for its use that cannot be met by other drugs and few thoughtful clinicians would be willing to do without its aid. Alcohol is often used in popular medicine without a correct conception of its action. Contrary to general belief it does not raise the bodily temperature, but actually causes it to fall on account of the increased radiation of heat from the surface of the body accompanying the dilatation of the blood vessels of the skin. Consequently alcoholic drinks should not be taken before exposure with the idea of avoiding fatigue or chilling, though there is no objection to its use when the exposure is over and the individual has returned home wet or chilled through.

Acute alcoholic poisoning follows the taking of very large quantities of strong spirits in a short time, and is not often seen. The patient promptly becomes comatose, the face is congested or purplish, there is complete muscular relaxation, weak heart action, and collapse, ending in death through paralysis of the heart or

of respiration, or both, unless medical aid is given. *Subacute alcoholism* is the ordinary type of drunkenness or "intoxication" and produces different manifestations in different individuals. The first effect of moderate amounts of alcohol is to cause exhilaration, garrulity, indistinctness and incoherency of speech, blunting of the sense of touch, and loss of muscular control so that the patient is unsteady on his feet and staggers when he walks. Dizziness and disturbances of sight and hearing may also appear, and finally a deep lethargy and stupor supervene. On awaking, nausea, vomiting, headache and mental depression remind the sufferer of his debauch. In some individuals the stage of hilarity does not appear and quarrelsomeness and moroseness are manifested from the start. The insensibility of alcoholic intoxication to some extent resembles that attending certain grave disorders like apoplexy, epileptic coma, fracture of the skull, or opium poisoning, and mistakes in diagnosis on persons found unconscious in the street are unfortunately not infrequent. The true state of affairs is often extremely difficult to recognize, and it is always wiser to treat doubtful cases as if the more serious trouble existed. The fact that the breath smells of liquor is of little value, as bystanders may have sought to aid a victim of other conditions in this way, or a man who has indulged in alcohol may also be suffering from some of the difficulties mentioned. Some persons instead of becoming stuporous pass into a condition of wild excitement and uncontrollable fury termed alcoholic mania, during which the most revolting crimes may be committed. In others convulsive seizures, or alcoholic epilepsy, may succeed the first stage. Dipsomania is a form of insanity in which the patient is subject to attacks of irresistible craving for liquor, though in the intervals he may be quite rational and alcoholic beverages may even be repugnant to him. Delirium tremens is a state of nervous unrest sometimes following a protracted debauch, sometimes appearing in steady, but not necessarily excessive, drinkers, usually as the result of some physical or mental shock. There are distaste for food, intense restlessness, terrifying hallucinations and illusions, and obstinate insomnia. The treatment of acute alcoholism comprises, first, elimination of the poison by washing out the stomach, purging, rectal irrigation with salt solution, and the Turkish bath, and secondly, the substitution of other stimulants such as ammonia, strychnine, caffeine, etc., until nourishment can be retained and strength returns. In delirium tremens the two great indications are to produce sleep and nourish the patient, problems that often tax the ingenuity of the physician to the utmost.

Chronic alcoholism is the result of long continued immoderate indulgence in alcoholic liquors and is a serious cause of disease. Nearly all the organs of the body are affected and exhibit a new growth of connective tissue. The blood vessels show the lesions of arteriosclerosis, the heart is affected in a variety of ways, commonly becoming fatty and weak, the kidneys develop nephritis, the liver cirrhosis, and the stomach is the seat of a chronic catarrhal condition giving rise to nausea, vomiting and distaste for food. There are congestive and catarrhal changes in the respiratory apparatus; the bodily strength is decreased and there is a tendency to obesity. There is also marked involvement of the nervous system leading to complete mental and moral deterioration with loss of will power, loss of memory, and incapacity for the responsibilities of life. Chronic alcoholics have lessened power of resistance to infectious diseases and readily break down under the stress of any mental or physical strain. The treatment of chronic alcoholism requires isolation of the patient, preferably in an institution, where no intercourse with friends will be possible. In one plan of treatment every article of food given the patient is soaked in liquor until the disgust awakened by its odor and taste is sufficiently great to ensure abstinence for a time at least. Some authorities advise immediate withdrawal of all alcohol, others recommend a more gradual process of "tapering off." Which method is preferable depends on the individual case. Hypodermic injections of nitrate of strychnine form the basis of some of the courses of treatment.

See INSANITY; TEMPERANCE. Consult: Cushing, 'A Textbook of Pharmacology and Therapeutics.'

KARL M. VOGEL, M. D.,
New York City.

Alcoran. See KORAN.

Alcorn, al'kern, **James Lusk,** American statesman: b. near Golconda, Ill., 4 Nov. 1816; d. 30 Dec. 1894. He was educated at Cumberland College; five years deputy sheriff of Livingston co., Ky.; member of the legislature 1843; in 1844 removed to Mississippi and began law practice, and was in the Mississippi legislature 1846–65. He was a Scott presidential elector in 1852, declined a Whig nomination for governor 1857, and the same year was defeated for Congress by L. Q. C. Lamar. He founded the levee system in the State. In 1861 he was in the Secession Convention, and was elected brigadier-general, but Jefferson Davis refused his commission from political grudge. In 1865 he was elected United States Senator, but not allowed to take his seat. In 1869 he was elected governor (Republican), but resigned on election to the United States Senate, where he served 1871–7. He was independent candidate for governor in 1873, but was defeated.

Alcott, Amos Bronson, American philosopher and educator: b. Wolcott, Conn., 29 Nov. 1799; d. 4 March 1888. In 1823 he set up an infant school, teaching it by conversation; and it gained much local fame. In 1828 he removed to Boston, and till 1836 conducted a school of the same sort, exciting wide attention by his genius for teaching, his revolutionary methods, and his exaggerated respect for the infant mind. His system was disfavored by most people, and in 1836 he removed to Concord, Mass., thenceforth expounding reform views on all human subjects, society and theology, diet and education, politics, morals, and metaphysics. He became an admired public lecturer in the great days of the lecture platform. In 1842 he visited England, where a Pestalozzian school near London had been named Alcott House. Returning with two English friends, one of them, Charles Lane, bought an estate in the town of Harvard, Mass., for a communistic

settlement, and the others joined him; but it failed. Mr. Alcott lived in Boston for a while, but finally returned to Concord, where he spent the remainder of his life as a « peripatetic philosopher,» as justly said: giving talks in different towns and cities on all human subjects when invited,— first at random, but latterly formal, with printed topics and regular places and periods. The conversation was nominally open, and questions in order; but it was soon found better to let it be a monologue by Mr. Alcott, who was put out by interruptions and could not argue. The company lost nothing; for though entirely unsystematic, and having no set philosophy which could have been developed into a school, he was fertile in ideas of deep spiritual insight and noble loftiness, and many leaders of thought, as Emerson, acknowledged him as a source of some of their best inspirations. In this characteristic of intellectual scrappiness, yet great molding influence, he may be compared with Coleridge and St. Simon. He was a leader among the Transcendentalists; and that he was an ardent Abolitionist goes without saying. His grounds in Concord represented his independence of mind and whimsicality: they were fenced by himself with gnarled pine boughs of endless diversity of form, apparently picked up as he walked. He contributed ‘Orphic Sayings’ to the *Dial*, of Boston (1839–42), and published many scattered papers; ‘Tablets’ (1868); ‘Concord Days,’ recollections of that place (1872); ‘Table Talk’ (1877); ‘Sonnets and Canzonets’ (1877).

Alcott, Louisa May, American novelist, daughter of A. B. Alcott: b. Germantown, Pa., 29 Nov. 1832; d. Boston, Mass., 6 March 1888, two days after her father. She was two years old when her parents moved to Boston; eight when they went to Concord. Her father was her chief teacher, on the system of his famous infant schools: as the latter developed no other geniuses, probably nature was responsible for hers. Thoreau also taught her for a time. She had always creative facility and sense of literary form, and began writing in early youth; at first for pleasure, then at 16 for periodicals to help support the struggling family, whose mainstay she continued all her life, her father's superiorities not being of the money-making order. But for many years afterward she groped for her true field, starting with sensational stories of no permanent merit. For ten years she was a school-teacher. In 1862 she went to Washington as a war hospital nurse, and wrote letters thence to her mother and sisters; on her return in 1863 she recast these into a volume entitled ‘Hospital Sketches,’ as the easiest available literary capital, not suspecting that she had found her kingdom. In these was first revealed her peculiar power of sketching commonplace people and scenes in all their commonplaceness, yet by the play of genial humor and rare selective art making them as charming as the best creations of the fancy. The success of these stimulated the publication of ‘Little Women’ (written 1867, after return from a year's European trip for impaired health, published 1868), which sold 60,000 copies the first year, and after 35 years remains one of the best copyrights in American literature. It raised her at once and justly to one of the front places in American authorship, and remains the one work of hers the world would much regret losing. In formal art it has no merits: there is no structure and no climax, merely detached scenes of an uneventful life; little delicacy of touch, though there are passages of much tenderness and pathos: but the healthy sense and stereoscopic lifelikeness make it rather an addition to people's actual experiences than their memories of fiction; and the girls, despite the blunt portrayal of surface faults and even over-harsh lack of idealization, are loved like sisters by millions. It is the world-photograph of the New England home and the American girl. This was her great opportunity: her own family and friends to « compose » and adorn, with scant need for imagination, of which she had little, or plot, in which she was very deficient. After this, with the necessity of inventing a set story, and her personal life mostly wrought into her previous work, her limitations were strongly apparent: ‘An Old-Fashioned Girl’ (1869), ‘Little Men’ (1871), and a series of later juveniles, though only less popular with the young than ‘Little Women,’ add nothing to her real reputation. They are also deformed by two unwholesome qualities: one derived from her father,— representing grown people mainly as vexatious interferences with children's enjoyment, and the latter as quite capable of teaching wisdom to their elders; the other a proof how much feminine craving lay underneath her spinster life,— making love-sentiment a sauce to everything from the kindergarten up, and the world one vast scene of « philandering.» But these pot-boilers had a higher motive and result than most money-earning, for they enabled her father to live his serene life. She adopted at different times a son of her sister, Mrs. John Pratt (« Meg ») and the orphaned daughter of her artist sister, Mme. Nieriken (« Amy ») ; and kept house for them and her father in vigorous New England fashion, caring for the latter like a baby. Fatigue and excitement during his last hours laid her low with a fatal brain fever. Besides the books above mentioned she published ‘Flower Fables or Fairy Tales’ (1855); ‘Moods’ (1864, revised 1881); a series, ‘Aunt Jo's Scrap Bag’ (1871–82); ‘Work, a Story of Experience’ (1873); ‘Eight Cousins’ (1874); ‘Rose in Bloom’ (1876); ‘Silver Pitchers’ (1876); ‘Under the Lilacs’ (1878); ‘Jack and Jill’ (1880); ‘Proverb Stories’ (1882); ‘Spinning-Wheel Stories’ (1884); ‘Lulu's Library’ (1885).

Alcott, May (Mme. Ernest Nieriken), American artist, daughter of A. B. Alcott: b. Concord, Mass., 1840; d. 1879. She studied at the Boston School of Design, and under Krug, Rimmer, Hunt, Vautier, Johnston, and Müller. Thenceforward she lived variously in Boston, London, and Paris; after marriage chiefly in the last. She did good work in still-life painting, both oil and water-color, and copied Turner so ably that Ruskin had some of the work adopted for models at the South Kensington schools. She published ‘Concord Sketches,’ with a preface by her sister (1869); ‘Art Studying Abroad’ (1879).

Alcoy, a town of Spain, in Valencia, 24 m. N. by W. of Alicante, near the source of the Alcoy, in a hollow encircled by hills. There is a Roman bridge over the river, and the town has

a very picturesque appearance. Its chief manufacture is paper, and it is likewise famed for sugar-plums. Pop. 32,000.

Alcuin, or **Flaccus Albinus,** an Englishman, renowned in his age for learning; the confidant, instructor, and adviser of Charlemagne. He was probably born in York in 735, and was educated under the care of Archbishop Egbert, and his successor Ælbert, with whom he went to the continent, and who afterward gave him the management of the school at York. Having gone to Rome to bring home the pallium (see PALLIUM) for Eanbert, the successor of Ælbert, Charlemagne became acquainted with him in Parma on his return; invited him, in 782, to his court, and made use of his services in his endeavors to civilize his subjects. In the royal academy he was called *Flaccus Albinus*. To secure the benefit of his instructions Charlemagne established at his court a school, called *Schola Palatina*, or the Palace School, and intrusted him with the superintendence of several monasteries, in which Alcuin exerted himself to diffuse a knowledge of the sciences. Most of the schools in France were either founded or improved by him; thus he founded the school in the abbey of St. Martin of Tours, in 796, after the plan of the school in York. He himself instructed a large number of scholars in this school, who afterward spread the light of learning through the empire of the Franks. Alcuin took his leave of the court in 801, and retired to the abbey of St. Martin of Tours, but kept up a constant correspondence with Charles to the time of his death in 804. He left, besides many theological writings, several elementary works in the branches of philosophy, rhetoric, and philology; also poems, and a large number of letters, the style of which, however, is not pleasing and plainly betrays the uncultivated character of the age; nevertheless he is acknowledged as the most learned and polished man of his time. He understood Latin, Greek, and Hebrew. The best edition of his works is that published at Ratisbon (1777, 2 vols. folio). See Lorenz's 'Life of Alcuin,' translated into English (London, 1837).

Alcyonaria (from Gk. *alkyon*[*e*]*ion*, bastard-sponge), a sub-class of coral polyps (*Anthozoa*), including fan-corals, «dead men's fingers,» organ-corals, the red coral used for beads and ornaments, and others. Eight tentacles around the mouth and the eight cells into which the body is divided are the characteristic elements of this group. See CORAL.

Alcyone, the brightest star of the Pleiades (q.v.). Also see KINGFISHER.

Al'dan, a river of E. Siberia, a tributary of the Lena, 1,200 m. in length, navigable for 600 m. The Aldan Mountains run along parallel to it on the left for 400 miles.

Aldana, Ramon, alda-na rä-mōn', Mexican poet: b. 1832; d. 1882. Besides four dramas, among which are 'Honor and Happiness' and 'Nobility of Heart,' he produced lyric poems and sonnets and contributed articles to journals.

Aldborough, or **Aldeburgh,** a small seaport and watering-place of Suffolk, 29 m. N.E. of Ipswich by rail. It was disfranchised in 1832; but in 1885 it received a new municipal charter. It has a quaint, half-timbered moot hall; and in the church is a bust of the poet Crabbe, who described the place in his poem, 'The Borough.' It has a two-mile promenade and lobster and herring fisheries. Pop. 2,150.

Aldeb'aran, a star of the first magnitude, forming the eye of the constellation Taurus or the Bull, the brightest of the five stars known to the Greeks as the Hyades. Spectrum analysis has shown it to contain antimony, bismuth, iron, mercury, hydrogen, sodium, calcium, etc.

Al'dehyde ("dehydrogenated alcohol," or alcohol which has been deprived of a portion of its hydrogen), a substance intermediate in composition between a primary alcohol and the corresponding acid. When an alcohol (q.v.) containing the molecular group $CH_2.OH$, is acted upon by oxidizing agents, it loses two atoms of hydrogen from this group, and becomes transformed into a substance which no longer contains the hydroxyl group (OH), and which is known as the «aldehyde» of the alcohol from which it was produced. Air effects the desired oxidization readily, when in the presence of platinum black. If the formula of the original alcohol is $R.CH_2.OH$, that of the corresponding aldehyde is R.CO.H. Aldehydes combine with bisulphites (or acid sulphites), producing compounds that are usually soluble in water, but insoluble in a solution of a bisulphite. Hence if a solution containing an aldehyde is shaken with a saturated solution of a bisulphite (such as $HNaSO_3$), the aldehyde is all thrown down in the form of an insoluble compound, from which the aldehyde itself may afterward be liberated by treatment with dilute sulphuric acid and distillation by steam. Aldehydes are easily oxidized into their corresponding acids, and on account of their affinity for oxygen they act as powerful reducing agents. An aldehyde may also be reconverted into the alcohol from which it was obtained, by the action of sodium amalgam. About 50 aldehydes are known, nearly all of which are volatile liquids.

The general relation of the aldehydes to their corresponding alcohols and acids may be illustrated by the following examples: The formula of methyl alcohol is $CH_3.OH$, or $H.CH_2.OH$. In the presence of platinum black, air oxidizes methyl alcohol in accordance with the following equation:

$$H.CH_2.OH + O = H_2O + H.CO.H.$$

H.CO.H (or CH_2O) is «formic aldehyde,» or «formaldehyde.» This rapidly absorbs oxygen and undergoes the change

$$\underset{\text{Formaldehyde}}{H.CO.H} + O = \underset{\text{Formic acid}}{H.COOH.}$$

Again, if ethyl alcohol ($C_2H_5.OH$, or $CH_3.CH_2.OH$) is treated in the same manner (or, better, if it is oxidized with a mixture of potassium bichromate and sulphuric acid), we have

$$\underset{\text{Ethyl alcohol}}{CH_3.CH_2.OH} + O = \underset{\text{Acetic aldehyde}}{CH_3.CO.H + H_2O.}$$

If allowed to absorb oxygen, acetic aldehyde then undergoes the further transformation

$$\underset{\text{Acetic aldehyde}}{CH_3.CO.H} + O = \underset{\text{Acetic acid}}{CH_3.COOH.}$$

Acetic aldehyde, or *acetaldehyde*.— When not qualified in any way aldehyde is understood to mean acetic aldehyde, the substance whose formation from ethyl alcohol has just

been described. Aldehyde (in this sense) is a colorless liquid with a suffocating smell, miscible in all proportions with water, alcohol, and ether, boiling at 70° F., and having a specific gravity of 0.800 at 32° F. It is capable of existing in several polymeric states, each having the same chemical composition as aldehyde, but differing from it in appearance and behavior. Thus although aldehyde may be preserved for a long time if kept in contact with excess of acid, in its pure state it soon deposits a solid substance known as metaldehyde, which sublimes at 250° F. without decomposition, and is reconverted into aldehyde when confined and heated to 400° F. By treatment with sulphuric or hydrochloric acid, aldehyde may be converted into a liquid known as paraldehyde, which boils at 255° F. and has a vapor density indicating the formula $3(C_2H_4O)$.

Aldehyde is used for silvering mirrors and other objects, on account of the property that it possesses (in common with other aldehydes) of throwing down a deposit of metallic silver when heated with a concentrated ammoniacal solution of silver nitrate containing a little caustic soda.

Alden, Bradford R., American soldier: b. Meadville, Pa., 1800; d. Newport, R. I., 10 Sept. 1870. Graduating at West Point 1831, he was instructor there 1833–40 after some camp and garrison life; then for nearly two years aide to Winfield Scott; after three years more of garrison duty was commandant at West Point 1845–52. Sent to the far West for service in the Puget Sound Indian troubles, in 1853 he organized and led an expedition against the Rogue River Indians of southwest Oregon; and in the fierce battle at Jacksonville 24 August, was permanently disabled and forced to retire from the army. He was a man of culture and fine literary tastes.

Alden, Henry Mills, American editor and author: b. Mt. Tabor, Vt., 11 Nov. 1836. He graduated 1857 at Williams College, in the class with Garfield and Horace E. Scudder; in 1860 at Andover Theological Seminary, and received license to preach, but was never ordained. He settled in New York in 1861; was managing editor of ‹ Harper's Weekly › 1863–9, and has been editor of ‹ Harper's Magazine › since 1869. His earliest interests were classical, especially in regard to ancient thought, religion, and literature: in the winter of 1863–4 he delivered 12 lectures at the Lowell Institute, Boston, on ‹ The Structure of Paganism ›; his earliest writings published were two papers on the Eleusinian Mysteries, in the ‹ Atlantic Monthly ›; and his classical scholarship is recognized as of a high type. In his editorial work he has sought to combine fresh intellectual outlook and the presentation of the latest results of scholarship with sound ethics and an elevating social tone; also to make the magazine American in the best sense and to bring forward new writers. He collaborated with A. H. Guernsey in ‹Harper's Pictorial History of the Great Rebellion› (1862–5); and has written ‹The Ancient Lady of Sorrow,› poem (1872); ‹God in His World› (1890, anonymous), and a ‹Study of Death› (1895), widely read and admired.

Alden, (Mrs.) **Isabella McDonald** («Pansy»), American juvenile writer: b. Rochester, N. Y., 3 Nov. 1841; married Rev. G. R. Alden 1866. She was educated at Ovid and Auburn, N. Y. While she has written fiction for adults, and ‹ The Prince of Peace,› a life of Christ, her chief note is as the author of the ‹ Pansy Books,› Sunday-school juvenile novels, about 60 volumes in all; and as editor of the juvenile periodical ‹ Pansy,› 1873–96. She has since been on the staff of the ‹ Christian Endeavor World › of Boston and the ‹ Herald and Presbyter › of Cincinnati. Her home is Philadelphia.

Alden, James, American naval officer: b. Portland, Me., 31 March 1819; d. San Francisco, Cal., 6 Feb. 1877. Becoming midshipman 1828, he accompanied the Wilkes expedition around the world 1838–42; commissioned lieutenant 1841, he served through the Mexican War in all the leading seaboard engagements. The Puget Sound Indian troubles called him thither 1855–6 for active duty. The Civil War found him in command of the steamer South Carolina, and he was sent to the Gulf and had a fight at Galveston, Tex.; later, in command of the sloop-of-war Richmond, he was at the passage of Forts Jackson and St. Philip and the capture of New Orleans and Port Hudson. He became captain 1863, and commanded the Brooklyn in the battle of Mobile Bay (August 1864) and the assaults on Fort Fisher; commodore 1866, and given charge of the Mare Island (Cal.) navy yard 1868; in 1869 made chief of the bureau of navigation, and in 1871 promoted to rear-admiral and assigned to command of the European squadron. He was retired 1873.

Alden, John, of the Plymouth colony: b. England, 1599; d. Duxbury, Mass., 12 Sept. 1687. His name is familiarized by Longfellow's poem ‹ The Courtship of Miles Standish.› He was originally a cooper of Southampton, was employed in making repairs on the Mayflower, and came over in her with the Pilgrim Fathers. By some accounts he was the first to step ashore at Plymouth. He married Priscilla Mullens: the tradition is (as used by Longfellow) that he had previously pleaded the cause of Miles Standish. He was for over 50 years a colonial magistrate, and highly esteemed for probity, sagacity, and resolution. All the distinguished Aldens of the United States are his descendants.

Alden, Timothy, inventor: b. Barnstable, Mass., 1819; d. December 1858. He was one of many thousands of printers who have dreamed of inventing type-setting machines, and of hundreds who have attempted it. He labored on one from 1846 till death, a horizontal rotating wheel with type-cells on its circumference, making receivers rotate with it to pick out the type at the proper places. His brother Henry W. improved the machine after his death.

Alden, William Livingston, American humorous writer and journalist: b. Williamstown, Mass., 9 Oct. 1837. He introduced the sport of canoeing into the United States. He was for a time United States consul-general at Rome. Among his principal writings are ‹ Domestic Explosives › (1877); ‹ Shooting Stars › (1878); ‹ The Canoe and the Flying Proa › (1878); ‹ Moral Pirates › (1880); ‹ The Comic Liar › (1882); ‹ Cruise of the Ghost › (1882); ‹ Life of Christopher Columbus › (1882); ‹ A New

Robinson Crusoe' (1888), etc. Since 1900 he has been London correspondent of the New York *Times*.

Aldenhoven, a town of Prussia, Rhine province; 12 m. N.E. of Aix-la-Chapelle. Here the French, in 1793, under Dumouriez, were defeated by 50,000 Austrians under Prince Josias of Coburg, and were prevented from making their contemplated invasion of Holland.

Alder, the common name for a genus of plants (*Alnus*), of the order *Cupuliferæ* (oak family). In the eastern United States it is a very common shrub, branching freely from the roots, and forming dense clumps along the banks of streams and in other wet places. On the west coast it often attains a height of from 40 to 60 feet in favorable locations. It is found in temperate and cold regions. The species familiar in England has a wood soft and light, but very durable in the water, and therefore well adapted to mill-work, sluices, piles of bridges, etc. Its bark and shoots are used for dye, and its branches for the charcoal employed in making gunpowder. The names black, red, and white-alder are often popularly applied to plants of other orders.

Alderman, Edward Sinclair, American clergyman and educator: b. Wilmington, N. C., 27 July 1861. He was graduated from Wake Forest College, N. C., in 1883 and the Southern Baptist Theological Seminary in 1886. He has held Baptist pastorates in Kentucky and has been president of Bethel College, Ky., from 1898.

Alderman, Edwin Anderson, American educator: b. Wilmington, N. C., 15 May 1861. He was educated at the University of North Carolina; was superintendent of the public schools of Goldsboro, N. C., 1884–87; assistant state superintendent of North Carolina, 1889–92; professor of English and history at the State Normal College, 1892–93; professor of the philosophy of education at the University of North Carolina, 1893–96; president of the latter institution, 1896–1900; president of Tulane University, 1900–1904, when he assumed the presidency of the University of Virginia. He has been active in educational work in the Southern States with the design of securing better schools and the increase of revenue from taxes for this purpose.

Alderman, a title pertaining to an office in the municipal corporations of Great Britain and the United States. In the United States the powers and duties of aldermen differ in the various States and cities. As a rule they are elected by popular vote and constitute the source of municipal legislation.

Alderman Lizard, or Chuckwalla, nicknames in California for a fat-bodied lizard (q.v.).

Al'derney (French Aurigny), an island belonging to Great Britain, on the coast of Normandy, 10 m. due W. of Cape La Hogue, and 60 from the nearest point of England, the most northerly of the Channel Islands. It is about 4 m. long and 1¼ broad, having an area of fully 3 sq. m. The coast is bold and rocky, the cliffs in many places rising from 100 to 200 feet in height. In the interior the soil is fertile, producing excellent crops of corn and potatoes. About a third of the island is occupied by grass lands; and the Alderney cows are famous for the richness of their milk. The climate is mild and healthy. The town of St. Anne is situated in a beautiful valley near the centre of the island. A judge, with six "jurats," chosen by the people for life, and 12 "douzaniers," representatives of the people, form a kind of local legislature; but the judge and jurats alone decide upon any measure, the douzaniers having only a deliberative voice. The French language still continues to prevail among the inhabitants, but all understand and many speak English. Alderney, Guernsey, Jersey, and Sark are the only parts of the Duchy of Normandy that have remained under the government of England since 1456. The Race of Alderney is a name given to the strait running between the coast of France and this island. Six miles northwest from Alderney are the Casquets, a cluster of rocks, on the largest of which is a lighthouse and a fog-bell. Pop. (1901) 2,062.

Aldershot, Camp at, a permanent camp for the army in England, commenced in 1854 by the purchase, on the part of government, of an extensive tract of moorland known by the name of Aldershot Heath, lying on the confines of Surrey, Hampshire, and Berkshire. The object was to accustom the officers and soldiers to act in brigades and divisions, and to familiarize them with the operations of a campaign by accustoming them to camp life, and exercising them in all the evolutions which they might be required to perform when brought into actual contact with the enemy. The Basingstoke Canal divides the camp into a North and a South Camp (otherwise known respectively as Marlborough and Stanhope Lines). The accommodation provided for the army consisted at first of wooden huts of the simplest construction; but these have been superseded by brick buildings, and altogether the money expended on the camp has amounted to upward of $20,000,000.

A town has sprung up in the neighborhood of the camp, immediately beyond the government ground, on the edge of which the camp is established. The town of Aldershot is in Hampshire, to the south of the barracks. It contains several churches, hotels, numerous shops, and offers accommodation of various kinds, good and bad, to the soldiers: thus there are schools, newspapers, missions, literary institutes, music-halls, public-houses, etc. Pop. (1901) 30,974 (including military).

Ald'helm, an Anglo-Saxon scholar and prelate, bishop of Sherborne: b. 640 (?); d. 709. He was a great fosterer of learning and builder of churches, and has left Latin writings on theological subjects.

Aldine Editions, the books printed by Aldus Manutius and his family in Venice (1490–1597). They comprise the first editions of Greek and Roman classics; others contain corrected texts of modern classic writers, as of Petrarch, Dante, or Boccaccio, carefully collated with the MSS. All of them are distinguished for the remarkable correctness of the typography; the Greek works, however, being in this respect somewhat inferior to the Latin and Italian. The editions published by Aldo Manuzio (1450–1515), the father, form an epoch in the annals of printing, as they contributed in no ordinary measure to the perfecting of types.

EDWIN ANDERSON ALDERMAN

PRESIDENT OF UNIVERSITY OF VIRGINIA

ALDER.

1. Tip of Twig with Budding Catkins (Alnus glutinosa).
2. Male Flowers.
3. A Single Flower, showing Anthers.
4. Female Flowers.
5. Stamens of Female Flower.
6. Fruit
7. Fruit Case.
8. Empty Fruit Case.
9. Twig, with Three Buds
10. Spray, with Fruit (Alnus incana).

No one had ever before used such beautiful Greek types, of which he got nine different kinds made, and of Latin as many as 14. It is to him, or rather to the engraver, Francesco of Bologna, that we owe the types called by the Italians *Corsivi*, and known to us as italics, which he used for the first time in the octavo edition of ancient and modern classics, commencing with Virgil (1501). Manuzio's impressions on parchment are exceedingly beautiful; he was the first printer who introduced the custom of taking some impressions on finer or stronger paper than the rest of the edition — the first example of this being afforded in the ‹ Epistolæ Græcæ › (1499). From 1515 to 1533 the business was carried on by his father and brothers-in-law, Andrea Torresano of Asola, and his two sons — the three Asolani. Paolo Manuzio (1512–74), Aldo's son, possessed an enthusiasm for Latin classics equal to that of his father for Greek; and he was succeeded by his son, the younger Aldo (1547–97). The printing establishment founded by Aldo continued in active operation for 100 years, and during this time printed 908 different works. The distinguishing mark is an anchor, entwined by a dolphin, with the motto either of « *Festina lente* » or of « *Sudavit et alsit.* » The demand which arose for editions from this office, and especially for the earlier ones, induced the printers of Lyons and Florence, about 1502, to begin the system of issuing counterfeit Aldines. The Aldo-mania has considerably diminished in later times. Among the Aldine works which have now become very rare may be mentioned the ‹ Horæ Beatæ Mariæ Virginis › of 1497, the ‹ Virgil › of 1501, and the ‹ Rhetores Græci, › not to mention all the editions, dated and undated, from 1490 to 1497, which are now extremely rare. See Renouard's ‹ Annales de l'Imprimerie des Aldes › (1834), and Didot's ‹ Alde Manuce › (1873).

Aldobrandi'ni, the name of a Florentine family, latterly of princely rank (now extinct), which produced one Pope (Clement VIII.) and several cardinals, archbishops, bishops, and men of learning.

Aldobrandini Marriage, an ancient fresco painting belonging probably to the time of Augustus, discovered in 1606, and acquired by Cardinal Aldobrandini, nephew of Clement VIII., now in the Vatican. It represents a marriage scene in which 10 persons are portrayed, and is considered one of the most precious relics of ancient art.

Al'dred, or **Ealdred,** Anglo-Saxon prelate, bishop of Worcester and archbishop of York: b. 1000 (?); d. 1069. He improved the discipline of the Church and built several ecclesiastical edifices. On the death of Edward the Confessor he is said to have crowned Harold. Having submitted to the Conqueror, whose esteem he enjoyed and whose power he made subservient to the views of the Church, he also crowned him as well as Matilda.

Aldrich, Anne Reeve, American poet and novelist: b. New York, 25 April 1866; d. there, 22 June 1892. She wrote ‹ The Rose of Flame › (1889); ‹ The Feet of Love, › novel (1890); ‹ Songs about Life, Love, and Death › (posthumous, 1892). Her early death was widely regretted from the brilliant promise of her work, especially in poetry: some of her lyrics of passion and regret are among the most perfect of American poetic gems in symmetrical art.

Ald'rich, Henry, dean of Christchurch, Oxford: b. 1647; d. 1710. He was distinguished as a writer on logic, as an architect, and as a musician. His ‹ Compendium of Logic › was a text-book till quite recently. He adapted many of the works of the older musicians, such as Palestrina and Carissimi.

Aldrich, James, American poet: b. Mattituck, L. I., 14 July 1810; d. New York, 9 Sept. 1856. His best known poem is ‹ The Death-Bed, › an imitation of Hood, preserved in most anthologies.

Aldrich, Nelson Wilmarth, American legislator: b. Foster, R. I., 6 Nov. 1841. A farmer's lad, with district-school education, he was clerk in a store from about 12 to 16; but, naturally studious and with a strong taste for mathematics, entered the East Greenwich Academy in 1857, and after graduation took a position in a large wholesale house in Providence, where he soon became a partner. In 1862 he was for nine months on garrison duty near Washington. In 1869 he was elected to the Providence Common Council, where he became a leader as expert in finance and business, and a dextrous manager without compromise of right, and was its president 1871–3. In 1875 he was elected to the legislature, and in 1876 was Speaker of its House. In 1878 he was sent to Congress, taking his seat in 1879 (Forty-second Congress); re-elected for the term 1881–3, he resigned in 1881, having been elected to the United States Senate on the 4th of October, to succeed Gen. Burnside, and has been three times re-elected,— in 1886, 1892, and 1898, practically without opposition in his party. During more than 20 years he has been known as one of the chief Republican leaders, an authority on finance and political economy, and a champion of protection; rarely taking part in debate, but powerful in legislative work, a member of committees on civil service and finance, and chairman of the committee on rules for the Fifty-fifth Congress. He was president of the Providence Board of Trade in 1878.

Aldrich, Thomas Bailey, author: b. Portsmouth, N. H., 11 Nov. 1836. Prepared for Harvard, but his father's death (1852) prevented a college career. Held editorial positions on the New York *Evening Mirror* and N. P. Willis' ‹Home Journal› till 1865. Edited ‹Every Saturday,› Boston, 1865–74, and ‹ The Atlantic Monthly, › 1881–90. As a poet he combines conciseness and aptness of expression with a faculty for bringing into conjunction subtly contrasted thoughts, images, or feelings. The best of his short stories are surpassed by no other American writer. In prose and verse he has ever held himself to the highest ideals of literary art and workmanship. His best known volumes are, in verse, ‹Cloth of Gold› (1874); ‹ Lyrics and Sonnets › (1880); ‹ Friar Jerome's Beautiful Book› (1881); ‹Ballad of Baby Bell › (1856); ‹ Wyndham Towers › (1890); ‹ Unguarded Gates and Other Poems › (1895); ‹ Mercedes, a Drama › (1883); in prose, ‹ Story of a Bad Boy › (1870); ‹ Marjorie Daw and Other People › (1873); ‹ Two Bites at a Cherry, and Other Tales › (1893); ‹ A Sea Turn › (1902).

Aldridge, Ira Frederick, American negro tragedian: b. (?); d. Lodz, Poland, 7 Aug. 1867. The discrepancies about his birth and training are monstrous, and indicate invention on one side. One is that he was a mulatto, born near Baltimore about 1810, who picked up German from immigrants, became Edmund Kean's servant, and developed stage talent under him in England, returned and made a theatrical failure in Baltimore 1830–1, then went back to England and became famous. The other is that he was son of a full-blooded negro pastor in New York city (Greene Street Chapel), an immigrant Senegal chieftain converted and educated, who sent his son to Glasgow University to study for the same profession, despite a passion for the stage justified by successful amateur performances; but the boy (at this point the stories coincide) dropped theology and made his début at the Royal Theatre as Othello. He took at once; and Kean made him Othello to his Iago in Belfast. He played Shakespearean roles in London till 1852, regarded as an excellent interpreter in all, but most liked in color-parts, such as Othello, Aaron in 'Titus Andronicus,' Rolla, Zanga, etc. He then played in Brussels and Germany 1852–5; the king of Sweden invited him to Stockholm in 1857. The Continent ranked him one of the foremost actors of the age, and the greatest sovereigns, with cities like Bern, showered honors and decorations on him and made him member of all sorts of learned societies. He married an Englishwoman. He was on his way to an engagement in St. Petersburg when he died.

Aldrovandi, Ulisse, Italian naturalist: b. Bologna, 11 Sept. 1522; d. 10 May 1605. He aroused interest in the natural sciences at a time when they had been long neglected, wrote profusely on natural history subjects, established the Botanical Garden of Bologna, and, through his legacy to the Senate of Bologna of his collections, left behind him the germ of the great Bologna Museum. A short account of his life, together with a descriptive list of his published writings and manuscripts, may be found in 'Notizie degli Scrittori Bolognesi,' Vol. I. (Bologna 1781). He was the first to collect an herbarium, in the modern sense of the word. He traveled widely, collecting plants and animals, and preparing himself to write a great work on the animal life of the world. Of this work four volumes on ornithology and one on mollusks were issued before his death, and 10 others, prepared by him from his material, were brought out afterward by his pupils and friends. Many of his manuscripts and drawings were preserved unpublished in the library of Bologna.

Ale and Beer, well known and extensively used fermented liquors, the best of which is prepared from barley after it has undergone the process termed malting. Beer is a more general term than ale, being often used for any kind of fermented malt liquor, including porter, though it is also used in a more special signification. "The numerous varieties of malt liquors met with in commerce may be resolved into three great classes — ale, beer, porter. Ale, as the term is generally understood, is a pale liquor brewed from lightly-dried malt, and abounding more or less in undecomposed saccharine matter and mucilage and the bitter and fragrant principles of the hop; characteristics which, however, it more or less loses by maturation and age. Beer is a fine, strong, well-fermented liquor, darker, less saccharine, and more alcoholic than ordinary ale. Porter is a dark-brown colored liquor, originally brewed from high-dried malt, but now generally made from pale malt, with a sufficient quantity of patent or roasted malt to impart the necessary color and flavor. Stout, brown stout, etc., are mere varieties of porter, differing from that liquor only in their superior strength and quality. East India ale, bitter ale, etc., of the great brewers, are beverages which combine the pale color and fragrant bitter of ale (the latter usually in undue excess) with the 'dryness' and maturity of beer. Table-ale or table-beer is a weak liquor, commonly containing three or four times the proportion of water usually present in ordinary beer or ale. In London porter is called beer, and indeed in all parts of the kingdom the prevailing beverage of this kind consumed by the masses, of whatever class, commonly goes by the name of beer. The three great classes of malt liquor above referred to are, independent of mere differences of strength, excellence, and commercial value, practically subdivided into an almost infinite number of varieties. Every county, every town, and almost every brewer is distinguished by the production of a different flavored beer, readily perceived and highly appreciated by their respective votaries" (Cyclopædia of Practical Receipts). These differences depend chiefly on the quality of the materials and the varying proportions in which they are employed, the temperature of the water used for mashing, the length of time the mash is boiled, the temperature at which fermentation is effected, and the extent to which it is allowed to proceed. The color of the beer depends on the color of the malt and the length of time occupied by the boiling. The pale ale is made from malt dried by steam or in the sun; the deep-yellow ale, from a mixture of pale, yellow, and brown malt; and the dark-brown beer from malt that has been highly dried in the kiln and partly carbonized, mixed with the paler sorts. Besides being made from barley, maize, wheat, and other grains, beer may be manufactured from a good many other amylaceous and saccharine substances, such as beet-root, potatoes, turnips, beans, cane-syrup, molasses, etc., but the best is that made from barley-malt. Some of these substances are extensively employed in Germany, which has been celebrated as a beer-drinking country from the earliest times. Many different kinds of beer are there made, among the most important being the Bavarian summer or lager (that is, store) beer, and winter beer, the Bavarian bock beer, Berlin white beer, wheat lager beer, Broyhan beer (Hanover), Merseburg brown beer, etc. The Bavarian beer possesses excellent qualities, and is distinguished from most of the beers of Germany and other countries by the valuable property of not turning sour on exposure to the air, so that it can be preserved in half-full casks equally well as in full ones. This quality it owes to the way in which it is fermented, this being done by the *untergährung* process, or process of fermentation from below. The malt-wort is set to ferment in open backs

with an extensive surface and placed in cold cellars with a temperature not higher than 46½° to 50°. The operation lasts three or four weeks, and the wort, instead of showing a large head of froth, is scarcely covered with any, the yeast sinking to the bottom in the form of a viscid sediment called the *unterhefe*, or bottom-yeast. This bottom-yeast is a different substance from the precipitate which falls to the bottom of the backs in the ordinary fermentation of beer. The summer or lager beer is brewed in the coldest months of the year, namely December, January, and February, and is stored up in air-tight cellars. The winter beer is intended for almost immediate consumption, and is hence called *schenk* (that is, pot or draught) beer. It is rather weaker than the summer beer. The Bavarian bock beer is a double-strength beverage of the best lager description, with a somewhat darker color than the ordinary lager beer and a sweeter taste. Berlin white or pale beer (*weissbier*) is brewed from one part of barley malt and five parts of wheat malt.

The manufacture of ale or beer is of very high antiquity. Herodotus ascribes the invention of brewing to Isis, and tells us that the Egyptians drank a liquor which they called *zuthos*, fermented from barley. Ale or beer was never used to a great extent in Greece or Italy, partly owing, no doubt, to the abundance of wine in these countries. Xenophon, in his 'Anabasis,' mentions it as being used among the inhabitants of Armenia, and the Gauls were also acquainted with it in early times. Ale or beer was in common use in Germany in the time of Tacitus. "All the nations," says Pliny, "who inhabit the west of Europe have a liquor with which they intoxicate themselves, made of corn and water (*fruge madida*). The manner of making this liquor is somewhat different in Gaul, Spain, and other countries, and it is called by many various names; but its nature and properties are everywhere the same. The people of Spain, in particular, brew this liquor so well that it will keep good for a long time. So exquisite is the ingenuity of mankind in gratifying their vicious appetites that they have thus invented a method to make water itself intoxicate." Our Teutonic ancestors would of course bring with them from the Continent their national beverage, and accordingly we find ale mentioned in English history in very early times. It is mentioned in the laws of Ina, king of Wessex (680), and ale-booths were regulated by law in 728. It was customary in the reigns of the Norman princes to regulate the price of ale, and a statute passed in 1272 enacted that a brewer should be allowed to sell two gallons of ale for a penny in cities, and three or four gallons for the same price in the country. The use of hops in the manufacture of ale and beer seems to have been a German invention, and the name beer appears to have come from Germany to England with this practice (1524), after which "beer" and "ale" were used respectively for the hopped and the unhopped liquor. In 1552 hop plantations had begun to be formed in England. Ale-houses were first licensed in 1621, and in Charles II.'s reign duties amounting to 2*s*. 6*d*. a barrel on strong, and to 6*d*. on small ale or beer, were imposed for the first time (1660). From that time up to 1830, when it was entirely repealed, though the malt-tax remained, the duty on the barrel of strong beer varied, being in 1804 as high as 10*s*. Up to 1823 beer was classed into strong beer and small beer, the former being beer of the value of 16*s*. and upward the barrel, the latter beer below this value. See also BREWING.

Alemanni. See ALAMANNI.

Aleardi, Gaetano, Italian poet and patriot: b. Verona 4 Nov. 1812; d. there 17 July 1878. From his boyhood he was devoted to the study of political and social questions, and was so active in the insurrection in Venetia (1848–9) that he was twice imprisoned by the Austrians. As a poet he has always been popular in Italy, and many editions of his works have been published.

Alembert, Jean le Rond d', a French mathematician and philosopher: b. Paris 16 Nov. 1717; d. there 29 Oct. 1783. The illegitimate child of Chevalier Destouches-Canon and the celebrated Madame de Tencin, sister of the archbishop of Lyons, he was abandoned in infancy near the church of St. Jean de Rond, a fact from which his Christian name was derived. After he had attained eminence his father recognized him and gave him a pension. While still very young he displayed such precocity of talent that he was placed in the College Mazarin, where he became deeply interested in mathematics and philosophy, and, in fact, while he attempted to study both medicine and law, his inability to turn his mind to either of these professions determined him to become a mathematician. In 1740, he was admitted to membership in the Academy of Sciences, and, a year later, he published his celebrated 'Treatise on Dynamics.' Other scientific work followed rapidly, and in 1750 he became associated with Diderot in the publication of the 'Encyclopedia,' for which he wrote the introduction, the article on mathematics, and many of the biographies. In 1754 he became a member of the French Academy, and in 1772, having declined several pressing invitations to become royal tutor at the court of Russia, he was elected perpetual secretary of the Academy. His 'Elements of Philosophy,' in which he followed the principles of Locke to their ultimate conclusion, both in skepticism and materialism, had appeared in 1759. Two editions of his works have been published: Paris, 1805, 18 vols. 8vo., and Paris, 1821, 5 vols. 8vo.

Alencar, Jose Martiniano de, celebrated Brazilian jurist and novelist: b. Ceara 1 May 1829; d. Rio de Janeiro 12 Dec. 1877. Although prominent in his profession he is best known as a writer of fiction, his most popular works being 'O Sertanejo,' 'Iracema,' and 'O Guarany,' all of which are stories of local Indian and colonial life.

Alessandria, Armistice of, the armistice under which the Austrian general, Melas, retired after the celebrated battle of Marengo, 16 June 1800. By this act Gen. Melas abandoned to Napoleon every fortification in northern Italy west of the Mincio, a result which, according to the opinions of the historians, was a more serious blow to the Austrian cause than an unconditional surrender would have been.

Alesund, a town on the western coast of Norway. Its chief industry is codfishing. Pop. about 12,000.

Aletia. See COTTON INSECT PESTS.

Aleurone, a substance rich in nitrogen, found in the cells of seeds. In the legumes it is found imbedded in the grains of starch, but in grains it constitutes the inner nodule. It is sometimes called gluten (q.v.).

Aleu'tian Islands, a chain of about 80 small islands belonging to Alaska Territory, separating the sea of Kamchatka from the northern part of the Pacific Ocean and extending nearly 1,600 miles from east to west between lon. 172° E. and 163° W.; total area, 6,391 sq. m. Pop. (1900), about 2,500. They are of volcanic formation, and in a number of them there are volcanoes still in activity. Their general appearance is dismal and barren, yet grassy valleys capable of supporting cattle throughout the year are met with, and potatoes, turnips, and other vegetables are successfully cultivated. They afford also an abundance of valuable fur and of fish. The natives belong to the same stock with those of Kamchatka. They are a strong hardy race, capable of enduring extremes of heat and cold. They are nominally Christianized, and are connected with the Greek Church of Russia. See ALASKA.

Alewife (possibly from *aloofe,* its Indian name), a small anadromous fish (*Pomolobus pseudoharengus*) found abundantly along the east coast of the United States, except at the extreme north and south. Somewhat earlier in the spring than its relatives, it goes up the rivers in multitudes to spawn. The eggs, which are voided in vast quantities, sink to the bottom and stick to rocks, etc. It is closely allied to both the herring and the shad, but it most resembles the shad in shape and color, though it is only from 8 to 10 inches long. It is less esteemed for its quality than the shad, but is of great importance as a food fish, and is taken by millions annually. This fish is called « gaspereau » in St. Lawrence Bay, and « branch herring » and « sawbelly » locally elsewhere; but the « alewife » of Bermuda is an entirely different fish, the round pompano.

Alexander, a name of various ancient writers, philosophers, etc. (1) ALEXANDER of Ægæ; a peripatetic philosopher of the 1st century A.D.; tutor of Nero. (2) ALEXANDER the Ætolian; a Greek poet who lived at Alexandria about 285–247 B.C., reckoned as one of the seven poets constituting the tragic pleiad. (3) ALEXANDER of Aphrodisias, surnamed Exegetes; lived about 200 A.D.; a learned commentator on the works of Aristotle. (4) ALEXANDER CORNELIUS, surnamed Polyhistor, of the 1st century B.C. He was made prisoner during the war of Sulla in Greece and sold as a slave to Cornelius Lentulus, who took him to Rome, made him the teacher of his children, and restored him to freedom. The surname Polyhistor was given him on account of his prodigious learning. The most important of his voluminous works was one in 42 books, containing historical and geographical accounts of nearly all the countries in the ancient world. (5) A Greek rhetorician and poet, surnamed Lychnus; lived about 30 B.C., wrote astronomical and geographical poems. (6) ALEXANDER NUMENIUS; a Greek rhetorician and teacher of elocution, of the 2d century A.D., two of whose works are historically known. (7) ALEXANDER the Paphlagonian; a celebrated impostor who lived about the beginning of the 2d century A.D., obtained a great influence with the people as an oracle; pretended to be Æsculapius reappeared. Lucian chiefly has made him known to us. (8) A Greek rhetorician of the 2d century A.D., surnamed Peloplaton, who vanquished Herodes Atticus in a rhetorical contest. (9) ALEXANDER PHILALETHES; a physician of the 1st century B.C., who succeeded Zeuxis as president of the famous Herophilean school of medicine. (10) SAINT ALEXANDER (d. 326 A.D.); the Patriarch of Alexandria from 312 A.D.; an opponent of Arius; member of the Council of Nice (325 A.D.); commemorated in the calendar 26 February. (11) ALEXANDER of Tralles; an eminent physician of Lydia, of the 6th century A.D.; author of two extant Greek works.

Alexander, the name of eight Popes.

1. ALEXANDER I., bishop of Rome about 109 A.D., recorded on the list of Popes by all the chronicles except Optatus Milevitanus. He confirmed, some say introduced, the rite of using unleavened bread for the Eucharist, of blessing water with salt, and certain rubrics in the mass. He died a martyr's death.

2. ALEXANDER II., Anselmo Baggio, a native of Milan; he lived for some time at the court of Henry III., and in 1056 or 1057 became Bishop of Lucca. In 1059 he became papal legate at Milan, and, 1 Oct. 1061, through the zeal of Hildebrand, he was raised to the papal throne, consequently the imperial party elected Bishop Cadaloüs of Parma, a rival Pope, as Honorius II. Alexander was driven by him in 1062 from the vicinity of Rome. He then withdrew to Lucca, and on the decision of the contest by Bishop Burchard of Halberstadt he was sent by the German court to Italy and recognized as Pope. At the Council of Mantua in 1604, with the assistance of Anno of Cologne, he got possession of Rome against his rival. His reign, under the influence of Hildebrand, carried out the reform of the churches and their emancipation from secular control. When Henry IV. wished a divorce from his wife Bertha, Alexander, through his legate, Cardinal Pietros Damiana, decided against him and summoned the king to Rome to answer for his crimes, but shortly after he died, 21 April 1073.

3. ALEXANDER III. (d. 1181), Rolando Ranuci; Pope, 1159–81. His career is historically important because of his vigorous prosecution, in opposition to Frederick Barbarossa, of the policies begun by Hildebrand. Three anti-Popes, Victor IV., Pascal III., and Calixtus III., had been confirmed in succession by the emperor. Alexander succeeded, and after the decisive victory at Legnano compelled Frederick's submission. The papal struggle was carried on in England by Thomas à Becket, ending in a victory for Alexander. William the Lion, of Scotland, was excommunicated for opposing him. Important decrees were issued by Alexander III., safeguarding ecclesiastical powers and privileges.

4. ALEXANDER IV., Pope 1254–61; a man of great gifts, which, however, were of little avail in his unfortunate times. His administration is

signalized by attempts to unite the Greek and Roman Churches, and the establishment of the Inquisition in France (1255). He was the nephew of Gregory IX. In his battle with Manfred of Sicily, he suffered bitter humiliations and, deserted by his bishops, was obliged to escape from Rome. He died in Viterbo in 1261.

5. ALEXANDER V., Pietro Philargi, of Candia. He was for some time professor in Paris, and in 1402 was made Archbishop of Milan, and in 1404 cardinal. In 1409, after the deposition of the rival Popes, Gregory XII. and Benedict XIII., he was elected Pope by the cardinals at the Council of Pisa, but was recognized by only a part of Christendom. He forbade the teaching of Wyclif in Bohemia, and prohibited Huss from preaching even in private chapels. He died at the age of 70, and it was supposed by some, though without foundation, that he was poisoned by his successor, Balthasar Cossa (Pope John XXIII.).

6. ALEXANDER VI., Roderick Llançol, was born at Cativa, in the diocese of Valencia, in Spain, 1 Jan. 1431. He assumed the name Borgia when his uncle of that name became Pope as Calixtus III. After studying law he entered the papal court and was advanced rapidly, becoming commendatory archbishop of Valencia, cardinal deacon, and vice-chancellor of the Church in Rome. Appointed cardinal-bishop of Albano in 1476, he was ordained priest in that year. By the unanimous consent of the cardinal electors he was crowned Pope 11 Aug. 1492. His administration was a remarkable one. He cleared Rome of the bandits who had infested the city; held court every Wednesday; established the Congregation of the Index for the censorship of books; repressed the insolence and rapacity of the Roman nobility; put a stop to the falsification of ecclesiastical documents; drew up measures for the reformation of ecclesiastical discipline; cooperated with European rulers in their projects against the inroads of the Saracens; effected peace between the kings of Spain and Portugal by repartitioning between them their discoveries in the New World; provided missionaries for preaching the gospel in newly explored countries; approved and confirmed several religious congregations; restored discipline in the Church in Flanders; suppressed magic in Germany and Bohemia; popularized the custom introduced by Calixtus III. of saying the Angelus at midday; encouraged arts, particularly painting and literature; put an end to the famines which had so often visited Rome; and issued many noted bulls, letters, and other papal documents, which alone show that he was a man of extraordinary genius and power.

He is charged by historians like Guicciardini and Burchard and more modern writers who follow them, of licentiousness before his ordination to the priesthood, of simony, nepotism, and cruelty as Pope. It is difficult to reconcile all the crimes attributed to him with his high qualities and distinguished deeds. Of late years the tendency of moderate historians is to exonerate him from many extreme charges, to extenuate the faults of his youth, and cast doubt on the serious accusations brought against him as Pope.

7. ALEXANDER VII., Fabio Chigi, of Siena, was during the treaties of peace at Münster and Osnabrück, papal nuncio in Germany. He was chosen Pope 7 April 1665, through the influence of France. In 1161, in spite of the protests of the Jansenists, he confirmed the condemnation of the five Jansenist dogmas which had been condemned by his predecessor, Innocent X. Later he fell into controversy with Louis XIV. During his rule Rome was beautified in many directions, especially by the colonnade before St. Peter's. He was himself a poet and friend of the arts and sciences. A collection of his poems appeared in 1656.

8. ALEXANDER VIII. (1610–91), Pietro Ottoboni, of Venice; Pope 1689–91; assisted Italy in wars against the Turks. Through the purchase of the library of Queen Christina of Sweden he enriched the Vatican with 1,900 precious manuscripts. The collection is known as the Ottobonian Library.

Cambridge 'Modern History,' Vol. I.; Hefele, 'History of the Councils'; Parsons, 'Studies in Church History'; Pastor, 'History of the Popes.'

Alexander I., emperor of Russia, son of Paul I. and Maria, daughter of Prince Eugene of Würtemberg: b. 23 Dec. 1777; d. 1 Dec. 1825. On the assassination of his father, 24 March 1801, Alexander ascended the throne, and soon after a ukase was published for diminishing the taxes, liberating debtors, etc. One of the first acts of his reign was to conclude peace with Great Britain, against which his predecessor had declared war. In 1803 he offered his services as mediator between England and France, and two years later a convention was entered into between Russia, England, Austria and Sweden for the purpose of resisting the encroachments of France on the territories of independent states. He was present at the battle of Austerlitz (2 Dec. 1805), when the combined armies of Russia and Austria were defeated by Napoleon. Alexander was compelled to retreat to his dominions at the head of the remains of his army. In the succeeding campaign the Russians were again beaten at Eylau (8 Feb. 1807), and Friedland (14 June), the result of which was an interview a few days after the battle, on a raft anchored in the Niemen, between Alexander and Napoleon, which led to the treaty signed at Tilsit, 7 July. The Russian emperor now for a time identified himself with the Napoleonic schemes. The seizure of the Danish fleet by the British brought about a declaration of war by Russia against Great Britain and Sweden, and Alexander invaded Finland and conquered that long-coveted duchy, which was secured to him by the peace of Friedrichshamn (1809). In 1809–12 war was carried on against Turkey. The French alliance, however, he found to be too oppressive, and his having separated himself from Napoleon led to the French invasion of 1812. In 1813 he published the famous manifesto which served as the basis of the coalition of the other European powers against France. After the battle of Waterloo, Alexander, accompanied by the emperor of Austria and the king of Prussia, made his second entrance into Paris, where they concluded (26 Sept. 1815), the treaty known as the Holy Alliance. The remaining part of his reign was chiefly taken up in measures of internal reform, including the

gradual abolition of serfdom, and the promotion of education, agriculture, commerce, and manufactures.

Alexander II., emperor of Russia: b. 29 April 1818; succeeded his father Nicholas in 1855, before the end of the Crimean war. After peace was concluded the new emperor set about effecting reforms in the empire, among the first being the putting of the finances in order. The greatest of all the reforms carried out by him was the emancipation of the serfs by a decree of 2 March 1861. The czar also did much to improve education in the empire and introduced a reorganization of the judicial system. During his reign the Russian dominions in central Asia were considerably extended, while to the European portion of the monarchy was added a piece of territory south of the Caucasus, formerly belonging to Turkey in Asia. A part of Bessarabia, belonging since the Crimean war to Turkey in Europe, but previously to Russia, was also restored to the latter power. The latter additions resulted from the Russo-Turkish war of 1877-8, in which the Turks were completely defeated, the Russian troops advancing almost to the gates of Constantinople. Toward the end of the czar's life several attempts at his assassination were made by Nihilists, and at last he was killed by an explosive missile flung at him in a street in St. Petersburg, 13 March 1881. He was succeeded by his son, Alexander III.

Alexander III., emperor of Russia, son of Alexander II.; b. 10 March 1845; d. Livadia, 1 Nov. 1894. He married the daughter of the king of Denmark in 1866. After his father's death, through fear of assassination, he shut himself up in his palace at Gatschina. His coronation was postponed till 1883, and was celebrated with extraordinary magnificence, and with national festivities lasting several days. Through the fall of Merv, the subjugation of the Turkomans in central Asia was completed. In 1885 hostilities with England with regard to the defining of the frontier between the Russian territories and Afghanistan for a time seemed imminent. In European affairs he broke away from the triple alliance between Russia, Germany, and Austria, and looked rather to France. He was aggrieved by the new Bulgarian spirit. His home policy was reactionary, though strong efforts were made to prevent malversation by officials, and stern economics were practised. The liberties of the Baltic provinces and of Finland were curtailed, the Jews were oppressed, and old Russian orthodoxy was favored. Several Nihilist attempts were made on his life, and throughout his reign he kept himself practically a prisoner in his palace.

Alexander I., king of Scotland, fourth son of Malcolm Canmore; b. about 1078, in 1107 succeeded his brother, Edgar, only, however, to that part of the kingdom north of the firths of Forth and Clyde; d. Stirling, 1224. He married Sibylla, a natural daughter of Henry I. of England, and his reign was comparatively untroubled, though about 1115 he had to quell an insurrection of the northern clans. He founded the abbeys of Scone and Inchcolm and initiated a diocesan episcopate; while his determined resistance to the claims of York and Canterbury to supremacy over the see of St. Andrews did much to secure the independence, not only of the Scottish Church, but of Scotland itself.

Alexander II., king of Scotland: b. Haddington, 1198; d. 1249. He succeeded his father, William the Lion, in 1214. He early displayed that wisdom and strength of character in virtue of which he holds so high a place in history among Scottish kings. His entering into a league with the English barons against King John drew down upon him and his kingdom the papal excommunication; but two years later the ban was removed, and the liberties of the Scottish Church were even confirmed. On Henry III.'s accession to the English throne, Alexander brought the feuds of the two nations to a temporary close by a treaty of peace (1217), in accordance with which he married Henry's eldest sister, the Princess Joan (1221). The alliance thus established was broken after her death without issue (1238) and the second marriage of Alexander with the daughter of a noble of France. In 1244 Henry marched against Scotland to compel Alexander's homage; but a peace was concluded without an appeal to arms. In 1249, while engaged in an expedition to wrest the Hebrides from Norway, Alexander died of fever on Kerrera, near Oban.

Alexander III., king of Scotland: b. 1241; succeeded his father, Alexander II., 1249; d. 12 March 1286. In 1251 he married the Princess Margaret (1240-75), eldest daughter of Henry III. of England. Very shortly after he had come of age his energies were summoned to defend his kingdom against the formidable invasion of Haco, king of Norway (1263), whose utter rout at Largs secured to Alexander the allegiance both of the Hebrides and the Isle of Man. The alliance between Scotland and Norway was strengthened in 1282 by King Eric's marriage to Alexander's only daughter, Margaret (1261-83); the untimely death of their infant daughter, Margaret, commonly designated the Maid of Norway, on her way to take possession of her throne, was the occasion of many calamities to Scotland. During the concluding years of Alexander's reign the kingdom enjoyed a peace and prosperity which it did not taste again for many generations. His only surviving son died without issue in 1284; and next year Alexander contracted a second marriage with Joleta, daughter of the Count de Dreux.

Alexander I., king of Servia: b. 14 Aug. 1876; son of King Milan I. In 1889 Milan abdicated and proclaimed Alexander king under a regency till he should attain his majority (18 years). On 13 April 1893, when in his 17th year, Alexander suddenly took the royal authority into his own hands and summarily dismissed the regent. On 5 Aug. 1900 he married Mme. Draga Maschin. This marriage was exceedingly unpopular by reason of the character of the new queen, and this fact, joined to her unwise attempts to advance her own family, induced a crisis which resulted in the assassination of the king and queen 11 June 1903. See SERVIA.

Alexander, Abraham, American agitator: b. North Carolina, 1718; d. 1786. His place in history is due to the fact that he was chairman

of the convention which on 31 May 1775 passed the resolutions generally known as the "Mecklenburg Declaration of Independence."

Alexander, Archibald, American clergyman, of Scottish descent: b. Virginia, 17 April 1772; d. Princeton, N. J., 22 Oct. 1851. He studied theology, and performed itinerant missionary work in various parts of Virginia; became president of Hampton-Sidney College in 1796, and pastor of a Presbyterian church in Philadelphia in 1807. On the establishment of Princeton Theological Seminary in 1812 he was appointed its first professor, a position which he held till his death. Among other works he published 'Outlines of the Evidences of Christianity,' 'Treatise on the Canon of the Scriptures' (1826); 'History of the Patriarchs' (1833); and 'History of the Israelitish Nation' (1852); his 'Moral Science' was posthumous.

Alexander, Barton Stone, American soldier: b. Kentucky, 1819; d. San Francisco, Cal., 15 Dec. 1878. He graduated from West Point 1842, and became lieutenant in the engineer corps; as such he superintended the building of Minot's Ledge lighthouse off Boston Harbor, the marine hospital at Chelsea, north of Boston, and the military asylum at Washington, besides repairs on fortifications. He assisted in constructing the defenses of Washington in the Civil War, took part in the first campaign about Manassas, and was brevetted major for conduct at Bull Run; and remaining with the Army of the Potomac was brevetted lieutenant-colonel for conduct at the siege of Yorktown in 1862. In 1864 he was consulting engineer on Sheridan's staff, and in March 1865 was brevetted brigadier-general for services in the war. The next two years he was in charge of the construction of the public works in Maine; and in 1867 became senior engineer with rank of lieutenant-colonel. Thence till death he was a member of the Pacific board of engineers for fortification.

Alexander, Cecil Frances (Humphrey), an Irish poet, born in County Wicklow, 1818: d. 12 Oct. 1895. She was very active in religious and charitable works. She is best known as a writer of hymns and religious poems. Among the most noted are the hymns, 'The Roseate Hue of Early Dawn' and 'All Things Bright and Beautiful.' Her most famous poem is 'The Burial of Moses.'

Alexander, Edward Porter, American military engineer: b. Washington, Ga., 26 May 1835. Graduating from West Point 1857, he was made second lieutenant in the engineer corps; resigned 1861, and entering the Confederate army served there till the surrender at Appomattox, April 1865; at first as chief of ordnance and chief signal officer in the Army of Northern Virginia, then as brigadier-general and chief of artillery in Longstreet's corps, taking part in the Wilderness and Spottsylvania and the siege of Petersburg. From 1866 to 1870 he was professor of mathematics and engineering in the University of South Carolina; thence (1871–92) manager and president of some of the foremost Southern railroads, and is a rice-planter in South Carolina. He was a government director of the Union Pacific R.R. 1885–7; a member of the boards on navigation of the Columbia River and on the Chesapeake-Delaware ship canal 1892–4; and in 1891 engineer arbitrator of the boundary survey between Nicaragua and Costa Rica.

Alexander, James, American colonial lawyer and patriot: b. Scotland about 1690; d. New York, 2 April 1756. He was an engineer officer in Scotland; compelled to leave Great Britain for taking part in the Old Pretender's Rebellion of 1715, he came to Perth Amboy, was its first official recorder in 1718, and was shortly after appointed surveyor-general of New York and New Jersey. Studying law, he rose to distinction at the bar. He engaged in political debate in the press; was temporarily disbarred for serving as counsel to a printer accused of sedition, but was reinstated two years later; held many important public offices, including those of attorney-general and of secretary to the province of New York; acquired a large fortune, and was a zealous upholder of colonial liberties, — he died from the fatigues of a journey from New York to Albany while sick, to oppose a ministerial project threatening colonial rights. With Franklin and others he founded the American Philosophical Society. His son was the famous "Lord Stirling" of the Revolution.

Alexander, Sir James Edward, a British soldier and explorer: b. in Scotland in 1803; d. 2 April 1885; served in the principal wars of his day, particularly distinguishing himself in the Crimean; conducted an exploring expedition into central Africa, and published several narratives of travel. He died 2 April 1885.

Alexander, James Waddell, American clergyman, son of Archibald Alexander: b. near Gordonsville, Va., 13 March 1804; d. 31 July 1859. He studied in Philadelphia, then graduated at Princeton and from its theological seminary. He held a pastorate at Charlotte C. H., Va., 1825–8, and the First Presbyterian Church in Trenton, N. J., 1828–30. Resigning from ill health, he became editor of the Philadelphia *Presbyterian.* He was professor of rhetoric and belles-lettres in Princeton, 1833–44; pastor of the Duane Street Church, New York, 1844–9; professor of ecclesiastical history and church government in Princeton Seminary, 1849–51; from 1851 till death pastor of his old Duane Street Church, reorganized as the Fifth Avenue, corner 19th Street. He wrote much for religious and other periodicals, and for the Tract Society, and over 30 volumes for the American Sunday-School Union. He published also volumes of sermons; 'The American Mechanic and Workingman' (2 vols. 1847); 'Plain Words to a Young Communicant' (1854); a biography of his father (1854); 'Discourses on Christian Faith and Practice' (1858); 'Thoughts on Preaching' (1864); etc

Alexander, John Henry, American scientist: b. Annapolis, Md., 26 June 1812; d. 2 March 1867. Graduating from St. John's College, Annapolis, 1826, he studied law, then engineering; and a plan for the survey of Maryland he put before its legislature gained him the appointment of topographical engineer of the State, which he held till 1841, preparing annual reports which did much to enlist capital in developing its coal and iron fields. He published a two-part 'History of the Metallurgy of Iron,' 1840–2. He was also associated in Hassler and

Bache's coast survey. He made great efforts to establish a uniform standard of weights and measures in the United States, and published in 1850 a 'Universal Dictionary of Weights and Measures, Ancient and Modern.' In 1857 the United States government sent him to England as a delegate to the British commission on international coinage, and his appointment to the directorship of the Philadelphia mint was only prevented by his death. He served on many commissions, and published very valuable reports; papers in the 'American Journal of Science and Arts,' etc. He was also at different times professor of physics in St. James' College, Maryland, the University of Maryland, and the University of Pennsylvania. He also wrote volumes of religious verse, an unpublished 'Dictionary of English Surnames,' etc., and edited scientific works.

Alexander, John White, American artist: b. Alleghany City, Pa., 7 Oct. 1856. For three years he was connected with the art department of the Harpers, and then was three years abroad, studying at the National Academy of Fine Arts, Munich, and with Duveneck in Venice and Florence. Upon his return to the United States he was active as a magazine illustrator. Attention was first attracted to his paintings by his exhibit in the Salon of the Champ de Mars in 1893. He received the gold medal of the Philadelphia Academy of Fine Arts in 1897, and gold medals at the Paris Exposition of 1900, and the Pan-American Exposition, Buffalo, in 1901. In 1902 he was elected an academician of the National Academy. He is represented in the Luxembourg and many American and European collections; and by six lunettes depicting 'The History of the Book' in the east hall of the Congressional Library, Washington.

Alexander, Joseph Addison, American Biblical scholar, son of Archibald Alexander: b. Philadelphia, Pa., 24 April 1809; d. 28 Jan. 1860. He graduated first in the Princeton class of 1826, and with R. B. Patton founded Edgehill Seminary there. He was adjunct professor of ancient languages at Princeton, 1830–3, then spent some years abroad in linguistic studies; from 1838 till death was professor at Princeton Seminary, 1838–50 of Oriental and Biblical literature, 1851–60 of church history and government, 1859–60 of New Testament history and Biblical Greek. He was ranked among the foremost of American Bibliologists, an Orientalist of high order, and a linguist of eminent variety and soundness. His exegetical works include commentaries on Isaiah (1846, 1847, 1851), the Psalms (3 vols. 1850), Acts (1857), Mark (1858), all indebted to German sources. His sermons were collected in 2 vols. 1860.

Alexander, Mrs., pseudonym of Annie Hector (q.v.).

Alexander, Romance of, a romance of the Middle Ages, based on a fabulous account of Alexander's invasion of Asia, written by Callisthenes. In some form it makes a part of all the literatures of Europe and western Asia.

Alexander, Sir William, Earl of Stirling, poet and statesman: b. 1567; d. London 1640. Tutor to Prince Henry, son of James I.; knighted 1609; held various high offices under the crown and in 1621 received the famous and stupendous grant of land embracing what is now Canada and the best portion of the New England States, and given almost absolute authority in its government, a grant that roused bitter envy among his contemporaries. At the coronation of Charles I. (1633) Alexander became Earl of Stirling. His last years were embittered by great pecuniary reverses and he died insolvent. In strength of character, integrity, and many-sidedness he was the greatest Scotchman of his time; took a conspicuous place as scholar, courtier, colonizer, and poet. As a poet he belongs to the type of Fulk Greville and Lord Brooke; his tragedies are labored; but some minor pieces like the 'Aurora' are elegant and musical. Milton read his works, and Addison praised them highly. The earliest editions of them bring high prices and are eagerly sought after. Chief among them are, 'Tragedie of Darius' (1603); 'A Parænesis to the Prince' (1604).

Alexander, William, general in Revolutionary War, known as "Lord Stirling": b. New York, 1726; d. Albany 15 Jan. 1783. He entered the service as a colonel of militia, was taken prisoner at the battle of Long Island, where he commanded a brigade, and served through the New Jersey campaigns with Washington. His claim to the title and estates of Stirling was disallowed by the English House of Lords in 1761, and on his return to America he took an active part in the troubles leading up to the Revolution. He was a member of the first board of governors of King's College, now Columbia University.

Alexander Archipelago, or **Alexander Islands,** a group of islands on the W. coast of North America, extending from 54° 40′ N. to 58° 25′ N.; belong to Alaska Territory. The principal islands are Baranoff and Prince of Wales.

Alexander Land, an area in the Antarctic Ocean, discovered by Bellinghausen in 1821. It is in lat. 68°, lon. 70° to 75°.

Alexander of Hales, a noted English philosopher and theologian: b. Hales, Gloucestershire; d. Paris 1245. One of the greatest of the schoolmen, he was among the first to study Aristotle from the point of view of the Arabic commentators. His chief work was 'The Sum of Theology' (1475).

Alexander of Rumania, Hospodar of Rumania: b. Husch 20 March 1820; d. Heidelberg 15 May 1873. On 29 Jan. 1859 he was chosen hospodar at Jassy and on 17 February at Bukharest, with title Alexander John I. By abolishing serfdom and dividing landed properties he benefited the peasantry, but his efforts toward centralization caused discontent, and on 22 Feb. 1866 he was compelled to abdicate.

Alexander Severus, Roman emperor (in full, MARCUS AURELIUS ALEXANDER SEVERUS): b. Ace (the modern Acre), Phœnicia, 205 A.D.; d. 235. He was the son of Genesius Marcianus and of Julia Mammæa, niece to the Emperor Severus. He was admirably educated by his mother, and was adopted and made Cæsar by his cousin Heliogabalus, then but a few years older than himself, at the prudent instigation of their common grandmother, Mæsa. That con-

temptible emperor, however, soon grew jealous of his cousin and would have destroyed him but for the interference of the prætorian guards, who soon after put Heliogabalus himself to death and raised Alexander to the imperial dignity in his 17th year, 11 March 222. Alexander adopted the noble model of Trajan and the Antonines, and the mode in which he administered the affairs of the empire, and otherwise occupied himself in poetry, philosophy, and literature, is eloquently described by Gibbon. On the whole, he governed ably both in peace and war; but whatever he might owe to the good education given him by his mother, he allowed her a degree of influence in the government which threw a cloud over the latter part of his reign. He himself finally became convinced that in this matter he had allowed his filial reverence to mislead him, and is said to have reproached his mother with his dying breath as the cause of the disaster which had befallen them both. Alexander behaved with great magnanimity in one of the frequent insurrections of the prætorian guards; but, either from fear or necessity, he allowed many of their seditious mutinies to pass unpunished, though in one of them they murdered their prefect, the learned lawyer Ulpian, and in another compelled Dion Cassius the historian, then consul, to retire to Bithynia. At length, after having defeated, in 232, the Persians under Artaxerxes, who wished to drive the Romans from Asia, and undertaking an expedition into Gaul to repress an incursion of the Germans, he was murdered with his mother in an insurrection of his Gallic troops, headed by the brutal and gigantic Thracian, Maximin, who took advantage of their discontent at the emperor's attempts to restore discipline. Alexander was favorable to Christianity, following the predilections of his mother, Julia Mammæa, and he is said to have placed the statue of Jesus Christ in his private temple, with those of Orpheus and Apollonius of Tyana.

Alexander the Great, the third king of Macedon bearing the name which he made so famous: b. Pella, 356 B.C.; d. Babylon, 323 B.C. His mother was Olympias, an Epirote princess, who traced her descent from Achilles. There is little reason to doubt that his father was Philip of Macedon, though the latter was not confident about his paternity, and though there is no evidence of any feelings between the two such as are expected to exist between father and son. On the contrary, Philip seems to have resented the imperial qualities of his son, which he was clever enough to see and appreciate; and Alexander showed a precocious envy of his father's neglected opportunities of conquest, a feeling which the sagacious biographer Plutarch has noted and dwelt on. No open rupture took place till Philip repudiated Olympias to wed a Macedonian lady (Cleopatra according to Plutarch and others, but Eurydice according to Arrian). During the nuptial feasting Philip made at Alexander with his sword, while the son jeered at his father's drunken fury and unsteady gait. In the assassination of Philip in 336 the repudiated and banished Olympias certainly had a hand, and we cannot be sure that Alexander was not an accomplice.

The memorable year in which Alexander first appeared on the stage of universal history was 339 B.C. At the age of 16 the regency of Greece was entrusted to him by Philip when he set out on an expedition against Byzantium; and in that capacity it fell to his lot to lead his first army against an Illyrian rising, to found his first Alexandria in the upper valley of the Strymon, and to receive a deputation of envoys from the king of Persia,— a fit beginning for the miracle of precocity who was afterward to destroy Thebes at 21, to conquer Babylon at 25, and to die master of the world at 33. In the year after his appointment to the regency Alexander showed eminent military capacity at the battle of Chæronea (338), and, on the murder of Philip, ascended the throne in 336, before he had reached his 20th year.

The brilliant natural gifts of Alexander had been developed under the tutelage of Aristotle. His personal beauty, with its ardent expressiveness and flashing eyes, was very remarkable, and he was pre-eminent in horsemanship and all athletic accomplishments. A habit (or perhaps some peculiar muscular conformation of the neck) which gave his head a tilt toward the left shoulder imparted to him an air of hauteur, which gave a note of eminent distinction to manners of charming grace and affability. He was of an extremely trusting disposition. His position in ascending the throne was a difficult one. He had enemies on every side. The Illyrians and Thracians were always watching an opportunity to attack Macedon, and indeed most of the Grecian states were ready, if possible, to throw off the Macedonian yoke. Persia regarded the growth of Macedon with suspicion; and finally his own Macedonian subjects were far from being united in approval of the career of conquest on which Philip and Alexander had both resolved to embark.

His reign began with an act of cruelty such as was destined subsequently to become almost a matter of course on every change of rulers; his uncle and his half-brother were put to death, and the little daughter of Cleopatra, Philip's widow, was butchered in the arms of her mother. In the autumn of 336 Alexander marched into Greece, and was confirmed in the chief command against Persia by the Amphictyones at Thermopylæ. In 335 he advanced to the Hæmus range (the Balkans), and showed great ability in his campaign against the Thracians, crossing the Danube — apparently out of mere bravado — in the face of the enemy without losing a single man. He had no real friends among the Greek states. The Thebans, hearing a false report of his death, became overt enemies, proclaimed their independence, and slew some Macedonian officers. Alexander appeared in Bœotia with amazing dispatch, and took Thebes by storm on the third day of the siege. This was the occasion on which, in the words of Milton,

> "The great Emathian conqueror bade spare
> The house of Pindar."

Leaving Antipater to govern in Europe, he crossed over into Asia in the spring of 334 with 30,000 foot and 5,000 horse. The Persian empire, the conquest of which he undertook, was at least 50 times as large as his own, and numbered about 20 times as many inhabitants. It extended from the Hellespont to the Punjab, from Lake Aral to the cataracts of the Nile.

But it was a vast congeries of subject provinces having no internal bond, and no principle of cohesion but the will of the king. For 80 years it had been tending to dissolution in its western provinces, which were the most exposed to danger. As stages in this process may be mentioned the revolt of Egypt under Amyrtæus in 410, and that of the Cypriote Evagoras, which was not put down till 383; the numerous revolts of satraps, of Greek cities, and of semi-Greek tyrants during the first half of the 5th century; and the attack on Persia made by Tachos, king of Egypt, in 361. It has been well remarked by Adolf Holm that the position of the Persian empire when attacked by Alexander had some resemblance to that of the Roman empire when overrun by the Germans. Both empires held together merely by the law of inertia; in both their strength lay not in their native elements, but in mercenaries taken from the very peoples, the Germans and the Greeks, who threatened respectively the safety of the two empires. Alexander proposed to himself nothing short of complete dispossession of Darius in favor of himself as captain-general of Hellas, and the establishment of his own Panhellenic empire in the room of the Persian. He was not led from point to point by this or that strategical reason. His business was not to leave Asia till every satrapy in the Persian empire acknowledged his sway. Even the burning of the Persian capital Persepolis was probably no act of drunken folly, as which it has often been described, but rather a signal and emphatic assertion of mastery and ownership, as of one who should say, "The Persian empire is mine, to throw it into the fire if I please." Alexander had no intention of remaining king of Macedon. His design was to be the Greek emperor of Europe and Asia; and this position in effect he assumed on the death of Darius. With this view throughout his whole career in Asia he sought as much as possible to fuse and commingle his Asiatic and European subjects, very much as England did in India. This was the project to which he was giving all his efforts at the time of his death.

The first hostile army he encountered was on the Granicus River (an affluent of the Sea of Marmora). He crossed the Granicus, just as he afterward crossed the Pinarus at Issus, in full view of the enemy, hurled himself with all his force on their centre and completely broke it up. It was not his way to refrain from the pass in *quart* till he had first hit in *tierce*. His victories sometimes remind us of the oft-quoted *C'est magnifique, mais ce n'est pas la guerre.* He won by an impetuous dash a victory which a subtler strategy might have failed to achieve, just as his sword-cut at Gordium made away with the knot which his fingers could not undo. The victory at Granicus was attended with unprecedented results; Sardes, Miletus, Ephesus, Halicarnassus submitted one after another, and he established in them democracies of the Greek type. In November, 333, Darius, eager to meet the invader, hastened to the sea-coast near Issus (at the head of the Gulf of Iskanderoon). The tactics pursued at the Granicus had here again a successful issue. Darius fled, leaving his family and his treasures in the hands of the conqueror. The mother, wife, two daughters, and son of Darius were treated with a clemency which foreshadowed the ages of chivalry. An Asiatic conqueror would have put the males to death, probably with torture, and would have sent the females to his harem. Captive Greek generals he also spared and liberated. He took possession of Damascus, a city which even then could boast of a hoary antiquity, and secured all the towns along the Mediterranean Sea. His plan now was to occupy Egypt, and this was made easy by the capture of Tyre on 20 Aug. 332, after a siege of seven months. During the siege a message came from Darius offering Alexander 10,000 talents, the hand of his daughter in marriage, and Asia as far as the Euphrates, if he would make peace. "I would accept it if I were Alexander," said his general, Parmenio. "So would I," replied Alexander, "if I were Parmenio." Gaza fell in November, 332, and Alexander, taking possession of Egypt, sacrificed to Apis and the Egyptian gods in Memphis, and held musical and athletic competitions after the Greek fashion in Tyre. Thus he conciliated the affections of his subjects. Politically he organized Egypt as a province in a way which, as Arrian remarks, foreshadowed the Roman system, giving the civil administration first to two, and then to a single governor, while the troops were placed under several separate commanders. It was now that Alexander founded the celebrated Alexandria — destined in two generations to be the first city in the Levant — and marched through the Libyan desert to consult the oracle of Jupiter Ammon, whose son he claimed to be.

Meantime Darius was collecting an army in Assyria; but before the decisive battle of Arbela he made overtures of peace to Alexander, whose answer was, "I, Alexander, hold all thy treasure and all thy land to be mine," — a verbal cutting of the Gordian knot. The Persian force encountered by the Greeks at Gaugamela, near the ancient Nineveh, and about 50 miles from Arbela (which strangely has given its name to the battle ever since), is said to have numbered 1,000,000 infantry, 40,000 cavalry, 200 scythed chariots, and 15 elephants. Alexander had only 40,000 foot and 7,000 horse, but he won a decisive victory on 1 Oct. 331. The Macedonians aimed at the faces of their adversaries, as the Cæsarians afterward did at Pharsalus. Babylon and Susa opened their gates to the conqueror, who then entered Persepolis, the capital of the province of Persis, seized its immense treasures, and burned its palace and citadel to the ground.

In the spring of 330 Alexander proceeded to Media in pursuit of Darius. That weak monarch was being carried about by Bessus, satrap of Bactria, who, on hearing of the approach of Alexander, inflicted a mortal wound on Darius and fled, leaving him to die. Darius died before Alexander came up with him (July, 330). The conqueror sent his body to Persepolis to be interred with royal honors. After taking possession of Hyrcania and Bactriana he was meditating still more gigantic plans, when he learned in the autumn of 330 that Philotas, the son of Parmenio, though cognizant of a conspiracy against his life, had not reported it. He put both Philotas and Parmenio to death. The execution of the former has been condemned, but is on the whole defensible; the murder of the latter is an inexcusable act of brutal tyranny. About the end

of 330 or the beginning of 329 he crossed the great range of the Caucasus (not the modern Caucasus, but the Hindu Kush) by a pass at an altitude of 13,200 feet — a march comparable with that of Hannibal over the Alps. He reached the city of Bactra (Balkh), and made his way north as far as the Jaxartes or Tanais, where he founded a city, probably the modern Khojend.

He remained in these regions till the summer of 327, spending the winter in Nautaca, on the right bank of the Oxus. Here occurred the murder of Clitus, and Alexander's marriage with Roxana, daughter of Oxyartes, a satrap of Sogdiana. She had a son named after his father in 323. After the death of Alexander she compassed the destruction of his other wife, the daughter of Darius, and was killed with her son in 311 by Cassander. The murder of Clitus has been regarded as a great blot on the career of Alexander. But the circumstances in which he was placed greatly extenuate the act. The East believed in the divinity of Alexander, and such a belief was almost an essential condition of the permanence of his empire. When one of his own officers openly denied and ridiculed the emperor's pretensions at a state banquet he seriously imperiled the Hellenic *raj*. The empire of Alexander was never subject to a second single emperor. The destinies of the West awaited the struggle between Rome and Carthage. But his vast empire nowhere save in India reverted to the pre-Alexandrine type.

Alexander now formed the idea of conquering India. He passed the Indus in 327, and formed an alliance with Taxiles, under whose guidance he reached the Hydaspes (modern Jhelum). This river he crossed after a severe struggle with Porus, in whom he met an opponent very superior to the Persian satraps who had hitherto confronted him or rather retreated before him. He then moved farther east and crossed the Acesines (Chenab) and the Hyraotes (Ravi), and reached the Hyphasis (Beas), which now joins the last river of the Punjab, the Sutlej, but which then flowed in a different channel. He never reached the Sutlej itself. The murmurs of his army compelled him to return. The fine instrument which he had fashioned so dexterously broke in his hand. He recrossed the Acesines to the Hydaspes, where he completed the cities of Nicæa and Bucephala (named after his famous horse Bucephalus), which he had already begun. He had only seen the fringe of India — the Punjab. The wondrous country of Brahma and Buddha never felt the sway of Secundar. It was the only land which, on his departure, reverted to its condition before his arrival. He was obliged to content himself with writing his name large across the histories of Hellenic, Semitic, Egyptian, and Iranian civilization. Alexander's name does not appear in Sanskrit literature.

When he had reached the Hydaspes he built a fleet, in which he sent part of his army down the river, while the rest proceeded along the banks. The city of the Malli, where Alexander was wounded, is probably Multan; Puttala is perhaps Haidarabad. The march of 500 miles through the hideous desert of Gedrosia (Baluchistan), and the voyage of Nearchus, have given much material to romancers and rhetoricians. At Carmania he was joined by Craterus, who had marched through the Bolan Pass to Kandahar, and by Nearchus, whose voyage, then thought so marvelous a feat, is no more than the short steam run from Karachi to Bunder Abbas. From Carmania he went to Pasargadæ, and thence to Susa, where he devoted himself with great energy to the task of uniting as far as possible the Macedonian and Persian nations. He himself married two Persian princesses, and he gave rewards to those of his staff who followed his example in contracting Persian alliances. He sent home to Macedonia, with a present of a talent each, about 10,000 Macedonians who by age or wounds were incapacitated for service. These veterans were led by Craterus, who was sent to succeed Antipater as governor of Europe. Antipater seems to have fallen into disfavor, though in 330 he had done service in defeating Agis, the Spartan king who threatened Megalopolis. It was of this exploit that Alexander contemptuously observed, "So there has been a battle of the mice in Arcadia, while we have been conquering Asia."

In 323 Alexander arrived at Babylon, where he found numberless envoys from nations near and far, come to pay their homage to the young conqueror. He was engaged in very extensive plans for the future, including the conquest of Arabia and the reorganization of the army, when he fell ill of a fever, shortly after the death of his beloved Hephæstion, which had deeply affected him. He died in 323, after a reign of 12 years and 8 months. The day before a rumor had gone abroad that the great general was dead, and that his friends were concealing the truth. The dying king caused his army to defile past his bed, and feebly waved them a last farewell. Alexander was a great administrator, a second Pericles in his devotion to work, an Alcibiades in his distinguished presence, a Phocion in his simplicity of character.

Alexander Yaroslavitch Nevski, a Russian hero and saint, the son of the Grand Duke Jaroslav: b. Vladimir, 1219; d. 1263. In order to defend the empire, which was attacked on all sides, but especially by the Mongols, Jaroslav quitted Novgorod and left the charge of the government to his sons, Fedor and Alexander, the former of whom soon afterward died. Alexander repulsed the assailants. Russia, nevertheless, came under the Mongolian dominion in 1238. Alexander, when Prince of Novgorod, defended the western frontier against the Danes, Swedes, and Knights of the Teutonic Order. He gained, in 1240, a splendid victory on the Neva over the Swedes, and thence received his surname. He overcame in 1243 the Livonian Knights of the Sword, on the ice of Lake Peipus. After the death of his father in 1247 Alexander became Prince of Novgorod, and, on the death of his brother Andreas, Grand Prince of Vladimir. The gratitude of his countrymen has commemorated the hero in popular songs and raised him to the dignity of a saint. Peter the Great honored his memory by the erection of a splendid monastery in St. Petersburg, on the spot where Alexander gained his victory, and by establishing the order of Alexander Nevskoi.

Alexandra Caroline Marie Charlotte Louise Julie, queen of England: b. 1 Dec. 1844; daughter of Christian IX. of Denmark, and wife of Edward VII., whom she married

10 March 1863. She has had three sons, two of whom are dead, and three daughters.

Alexandretta (the ancient ALEXANDRIA AD ISSUM), a small seaport in Syria, on the S.E. coast of the Gulf of Iskanderoon. It is the natural port of Aleppo and northern Syria. The town is rendered unhealthy by the surrounding marshes, but this has been partially remedied by draining one of the largest. The port is a fine bay, running southeast from the Gulf. The imports are chiefly grain, rice, and salt; the exports, galls, silk, cotton, and dips or beshmet (a preparation from grapes, used by the natives as food). Pop. about 3,000.

Alexandria (ISKANDERIEH of the Turks), an ancient city and seaport in Egypt, about 14 miles west of the Canopic mouth of the Nile, on the ridge of land between the sea and the bed of the old Lake Mareotis. Ancient Alexandria was founded by, and named in honor of, Alexander the Great, in 332 B.C., on the site of a village called Rakôtis or Racoudah. Its plan was sketched by the architect Dinocrates. It stood nearly on the site of the present town, though the configuration of the land has altered considerably since then, was 15 miles in circumference, and had 300,000 free inhabitants and at least an equal number of slaves. The Romans ranked it next to their own capital, and when captured by Amru, general of the Caliph Omar (A.D. 641) it contained "4,000 palaces, 4,000 baths, 400 theatres or places of amusement, 12,000 shops for the sale of vegetables, and 40,000 tributary Jews" (Gibbon). The city was regularly built and traversed by two principal streets, each 100 feet wide and one of them 4 miles long. It consisted of two quarters, *Rakōtis*, or the people's quarter, and *Brucheion*, or the quarter of the palace. One fourth of the area upon which it was built was covered with temples, palaces, and public buildings, the most conspicuous being the famous lighthouse upon the little island of Pharos, which was connected with the city by a mole; the splendid temple of Jupiter Serapis; the Library, at that time the richest in the world; the Museum, a kind of academy in which learned men of every description were entertained at the expense of the state; an immense hippodrome; numerous obelisks and pillars, among which were Pompey's Pillar, or more properly Diocletian's Pillar, and the two obelisks known as Cleopatra's Needles. Pompey's Pillar occupies an eminence 1,800 feet to the south of the present walls; its total height is 98 feet 9 inches; the Needles, of red granite, and 70 feet high, stood on the edge of the eastern harbor. One was taken to London in 1878; the other stands in Central Park, New York. The city was bombarded by the British 11 July 1882. (See EGYPT.)

The present city is chiefly built on the mole, which has been increased by alluvial deposits till it has become a broad neck of land between the two harbors. The European quarter swarms with cafés, shops, and theatres, lighted with gas. The castle stands near the old Pharos, and the handsome new lighthouse has a revolving light visible at a distance of 20 miles. Recent improvements, undertaken at a cost of $10,000,000, are expected to make the western or the old harbor by far one of the best and most spacious on the Mediterranean. There is railway communication with Cairo and Suez; the Mahmoudieh canal, made by Mehemet Ali, connects Alexandria with the Nile. Pop. (1902) about 400,000.

Alexandria, Ind., a city in Madison co., on the Cleveland, C., C. & St. L., and Lake Erie & W. R.R.'s, 45 miles N.E. of Indianapolis. It is in a natural gas region and has large window glass and lamp chimney factories, and manufactures of paper, steel, axes, and mineral wool. It has municipal water and lighting plants; churches, schools, banks, and daily, tri-weekly, and weekly newspapers. It was settled in 1837 and is governed by a mayor, elected for four years, and a council of six members. Pop (1890) 715; (1900) 7,221.

Alexandria, La., a town of Rapides parish about 100 miles N.W. of Baton Rouge on the Red River, in the centre of the State, in the midst of a fine farming country. It is becoming quite a railroad centre, the following roads having entered the town: Texas & Pacific, St. Louis, Iron Mountain & Southern, Southern Pacific, St. Louis, Watkins & Gulf, Louisiana Railway & Navigation Co. It has a number of institutions of learning, a $50,000 public school building, and a convent of the Sisters of Mercy. It has a number of miles of asphalt street paving. The State has recently erected an institution for the insane here. The town does a good wholesale and retail business, and has a good trade in molasses, hides, sugar, cotton, and lumber. Here in 1864 a dam was built by Lieut.-Col. Bailey, by which a Federal squadron during Banks' expedition was enabled to pass the rapids. Pop. (1904) est. 10,000.

Alexandria, Va., city, port of entry, and county-seat of Alexandria co.; situated on the Potomac River, the Pennsylvania & So. R.R.'s, and trolley line connecting with Washington, D. C., and Mt. Vernon; 6 m. S. of Washington. The river here expands to the width of a mile and gives the city an excellent harbor that will accommodate the largest vessels. The city is an important trade centre; has manufactures aggregating $20,000,000 annually, and is noted for its educational institutions, which include Washington High School, Potomac, Mt. Vernon, and St. Mary's Academies, and near by the Theological Seminary and High School of the Diocese of Virginia (Protestant Episcopal). There are four national banks, public school property valued at $35,000, and daily and weekly periodicals. Gen. Braddock made his headquarters here in 1775, and in 1861 Col. Ellsworth, an officer in Maj.-Gen. McDowell's army, was shot after tearing down a Confederate flag which floated from the Marshall House. Pop. (1900) 14,528.

Alexandria Bay, N. Y., a village in Jefferson co., on the Rome, W. & O. R.R., about 70 m. N. E. of Oswego. It is a prominent resort of the Thousand Islands. Pop. (1900) 1,511.

Alexandrian Age, or **School**, the school or period of Greek literature and learning that existed at Alexandria in Egypt during the 300 years that the rule of the Ptolemies lasted (323–30 B.C.), and continued under the Roman supremacy. Ptolemy Soter founded the famous library of Alexandria (see below) and his son, Philadelphus, established a kind of academy of sciences and arts. Many scholars and men of genius were thus attracted to Alexandria, and

MAHMOUDIEH CANAL, AT ALEXANDRIA, EGYPT.

a period of literary activity set in which made Alexandria for long the focus and centre of Greek culture and intellectual effort. It must be admitted, however, that originality was not a characteristic of the Alexandrian age, which was stronger in criticism, grammar, and science than in pure literature. Among the grammarians and critics were Zenodotus, Eratosthenes, Aristophanes, Aristarchus, and Zoilus, proverbial as a captious critic. Their merit is to have collected, edited, and preserved the existing monuments of Greek literature. To the poets belong Apollonius, Lycophron, Aratus, Nicander, Euphorion, Callimachus, Theocritus, Philetas, etc. Among those who pursued mathematics, physics, and astronomy was Euclid, the father of scientific geometry; Archimedes, great in physics and mechanics; Apollonius of Perga, whose work on conic sections still exists; Nicomachus, the first scientific arithmetician; and (under the Romans) the astronomer and geographer Ptolemy. Alexandria also was distinguished in philosophical speculation, and it was here that the New Platonic school was established at the close of the 2d century after Christ by Ammonius of Alexandria (about 193 A.D.), whose disciples were Plotinus and Origen. Being for the most part Orientals, formed by the study of Greek learning, the writings of the New Platonists are strikingly characterized — for example, those of Ammonius Saccas, Plotinus, Iamblicus, Porphyrius — by a mixture of Asiatic and European elements. The principal Gnostic systems also had their origin in Alexandria.

Alexandrian Library, a remarkable collection of books, the largest of the ancient world, was founded by the first Ptolemy and fostered by his son. It quickly grew, and already in the time of the first Ptolemy, Demetrius Phalereus had 50,000 volumes or rolls under his care. During its most flourishing period, under the direction of Zenodotus, Aristarchus of Byzantium, Callimachus, Apollonius Rhodius, and others, it is said to have contained 490,000, or, according to another authority, including all duplicates, as many as 700,000 volumes. The greater part of this library, which embraced the collected literature of Rome, Greece, India, and Egypt, was contained in the famous Museum, in the quarter of Alexandria called the Brucheion. During the siege of Alexandria by Julius Cæsar this part of the library was destroyed by fire; but it was afterward replaced by the collection of Pergamos, which was presented to Cleopatra by Mark Antony. The other part of the library was kept in the Serapeum, the temple of Jupiter Serapis, where it remained till the time of Theodosius the Great. When this emperor permitted all the heathen temples in the Roman empire to be destroyed, the magnificent temple of Jupiter Serapis was not spared. A mob of fanatic Christians, led on by the Archbishop Theophilus, stormed and destroyed the temple, together, it is most likely, with the greater part of its literary treasures, in 391 A.D. It was at this time that the destruction of the library was begun, and not at the taking of Alexandria by the Arabs under the Caliph Omar, in 641. There are strong reasons for believing that no library then existed there.

Cf. Petit-Radel, 'Recherches sur les Bibliothèques Anciennes et Modernes' (1819); Ritschl, 'Die Alexandrinische Bibliothek' (1838): Weniger, 'Das Alexandrinische Museum' (1875).

Alexandrian Version, or **Codex Alexandrinus** (Codex A.), a Greek manuscript of the Bible, now in the British Museum, of great importance in Biblical criticism. It is on parchment, with uncial letters, without breathings and accents or spaces between the words. It was written probably in the middle of the 5th century, and contains, in four volumes, small folio, the whole Greek Bible, two letters of Bishop Clement of Rome to the Corinthians, the genuine epistle and a fragment of the second, the spurious one, and eight psalms of Solomon, so called. The first three volumes contain the translation of the Old Testament; the fourth, the New Testament. A large part of the Gospel of St. Matthew and of the Second Epistle to the Corinthians, as well as a portion of the Gospel of St. John, are wanting. The patriarch of Constantinople, Cyrillus Lucaris, who in 1628 sent this manuscript as a present to Charles I., said he had received it from Egypt; and it is evident from other circumstances that it was written there. But it cannot be decided with certainty whether it came from Alexandria (whence its name). It is said, however, to have belonged to the patriarch of Alexandria at the end of the 11th century. John Ernest Grabe followed it in his edition of the Septuagint (Oxford, 1707–20, folio, 4 vols.). Dr. Woide published the New Testament (London, folio, 1786), with types cast for the purpose, page for page and line for line, as in the manuscript itself. A somewhat more accurate text of the New Testament in ordinary Greek type (with the lacunæ supplied) was published by R. H. Cowper in 1860. Henry Hervey Baber edited a facsimile edition of the Old Testament (London 1816–28, 3 vols. folio.). In 1864 the complete text, along with three other of the oldest texts of the Bible, was published at Oxford, the work being arranged in parallel columns. An autotype facsimile of the whole codex in four volumes was published by the British Museum in 1879–83. The text of this manuscript is of most importance in the criticism of the Epistles of the New Testament; in the Gospels the text is not so good.

Alexandrine, the name of a verse, which consists of 6 feet (or of 6½ with female rhymes), equal to 12 syllables, the pause being in correct Alexandrines always on the 6th syllable; for example, the second of the following verses (from Pope's Essay on Criticism):

"A needless Alexandrine ends the song
That, like a wounded snake, drags its slow length along."

The only complete English poem of literary importance written in this measure is Drayton's 'Polyolbion.' The concluding line of the Spenserian stanza is an Alexandrine. The French in their epics and dramas are confined to this verse, which for this reason is called by them the Heroic. The Alexandrine derives its name from an old French poem belonging to the middle of the 12th or the beginning of the 13th century, the subject of which is Alexander the Great, and in which this verse was first made use of.

Alexandrite, a variety of the mineral chrysoberyl (q.v.). It occurs in twin crystals (trillings) and is chiefly remarkable for the fact that while by daylight its color is a dark emerald to grayish-green, it assumes a beautiful columbine-red color by artificial light. Because of this property, and owing to its rarity and great hardness (8.5), it is highly prized as a gem. Its name, given in honor of Alexander II. of Russia, seems singularly appropriate when it is recalled that the gem is said to have been first discovered in the emerald mines of Takowaja, Siberia, on the very day on which the then heir apparent attained his majority, and further that the green and red colors of alexandrite are the national colors of Russia. The finest alexandrites still come from Siberia, but good gems are occasionally found in Ceylon.

Alexandropol (formerly GUMRI), a Russian town and fortress in the trans-Caucasian government of Erivan, situated on a bare plateau near the highway from Erivan to Kars. There is accommodation in the military quarters for a force of 10,000 men. The town has several churches and caravanserais, and there are extensive silk manufactories. Pop. 32,078.

Alexia. See APHASIA.

Alexiad, a life of the emperor Alexis Comnenus (q.v.) by the Princess Anna Comnena, his daughter. This work, which is one of the most important authorities for the history of the closing years of the 11th century, is written in modern Greek and divided into 15 books. It gives a vivid picture of the First Crusade.

Alexian Brothers. See CELLITES.

Alexis, a Greek comic poet, a native of Thurii, in Magna Græcia, afterward an Athenian citizen: b. about 394 B.C., and is known to have lived as late at least as 288 B.C. He was the uncle and instructor of Menander, and is said to have written 245 plays.

Alexis, Wilibald, pseudonym of Wilhelm Häring (q.v.).

Alexis Mikhailovitch, second Russian czar of the line of Romanof. See RUSSIA.

Alexis Petrovitch, the eldest son of the czar Peter the Great and Eudoxia Lapuchin: b. in Moscow, 1690. He oppcsed the innovations introduced by his father, who on this account determined to disinherit him. Alexis renounced the crown, and when Peter set out on his second journey he made his escape in 1717 to Vienna, where he sought the protection of his brother-in-law, the German emperor, and thence to Naples, under the pretext of going to his father, who had sent for him. At the command of Peter he returned; but the enraged czar, regarding his flight as an act of treason, disinherited him by a ukase of 2 Feb. 1718; and when he discovered that Alexis was paving the way to succeed to the crown he not only caused all the participators of his project to be punished capitally or otherwise, but had his son also condemned to death, and the sentence read to him, as pronounced unanimously by 144 judges. Although he was soon afterward pardoned, the fright and anxiety which he had experienced affected him so much that he died in the course of four days, 7 July 1718. It is supposed by some that he was poisoned. He left a daughter and a son, afterward the emperor Peter II.

Alexius (COMNENUS), emperor of Constantinople: b. 1048; d. 15 Aug. 1118. He was the third son of John Comnenus, the emperor Isaac's brother. Naturally clever, he was carefully educated under the direction of his mother; and at the age of 14 took part in an engagement with some European adventurers commanded by a Scot called Russel de Balliol, of whom the youthful warrior afterward became an intimate friend. After several successive emperors had tasted for a brief season the «bitter sweets» of a nominal supremacy over a country torn by anarchy, Alexius, with the aid of the army, was proclaimed emperor, seized on Constantinople, which he permitted his soldiers to pillage, and shut up the nominal ruler in a monastery (1081). The empire was then in a deplorable state. The Turks were profiting by these intestine dissensions to seize upon the Asiatic provinces while Robert Guiscard and his Normans were menacing the west, and fierce swarms from beyond the Danube threatened the nearer provinces. However, Alexius did not despair; he sent supplies of money to his ally Henry IV. of Germany to enable him to attack Rome, the Pope (Gregory VII.) being a firm friend of the Norman leader. His Holiness had to flee, and Guiscard hastened to his aid, leaving in Greece his son Bohemond, who gained two victories over Alexius; but famine and disease weakened the Norman army, which Robert could not rejoin, as he was detained in Italy by a revolt of his vassals. In 1084 he returned to the charge, and after gaining some advantages he suddenly died of an epidemic; although some ascribe his death to poison administered by one of Alexius' secret agents. In consequence of this event the Normans abandoned all their conquests, and Alexius turned his attention to the Turks and Scythians, whom, after an arduous struggle, he completely defeated. Scarcely was this accomplished when, in 1096, the bands of the first Crusade arrived at Constantinople demanding aid, rudely menacing him in his own palace, and finally compelling him to join them. The alliance did not last long; a war broke out between the emperor and the Crusaders, which ended in the defeat of the latter. The rest of Alexius' life was employed in consolidating his conquests and restoring orderly government in his states, which were much disturbed by heresies. He died at 70, after a reign of 37 years. He extended his empire; and for its defense he left to his successors a well-disciplined army, which he had wholly created himself. Historians differ respecting his conduct and abilities; his daughter Anna wrote his life (the Alexiad).

Alfalfa, also called LUCERNE (q.v.) (*Medicago sativa*), is a herbaceous plant belonging to the natural order *Leguminosæ*. The leaves are pinnate-trifoliate; its flowers small, generally purple in color, situated in the axillary spikes. The plant is a native of Asia, but has been cultivated in Europe since before the time of Christ. The Spaniards introduced it into South America, but it did not reach North America until some time between 1850 and 1860, when it was introduced into California. Since then it has become the most extensively cultivated forage crop in the United States. Its adaptability to varying conditions of soil

and climate gives it an extensive range, extending from the arid lands of the West, where irrigation is required, to the richer soils of the East, and from sea-level to heights of over 7,000 feet. It will not flourish in extremely damp or clayey soils. Its roots strike to great depths, so that it withstands droughts better than most of the forage plants. It is cut when coming into bloom, and yields from 3 to 12 tons of hay to each acre. In some regions it is cut every month in the year. It is particularly valuable as a green manure, as it takes nitrogen from the air, and its deep-growing roots draw from the lower soils large quantities of lime, phosphoric acid, potash, and other minerals useful as crop foods. Alfalfa is relished by cattle whether green, as hay, or as ensilage, but to secure the best results it should be fed with root crops and grain, which add the ingredients needed for a well-balanced ration. Alfalfa is subject to two fungus diseases, one on the leaf and another on the root, either of which, if not checked, will spread and ultimately ruin the field. The ‘Farmers' Bulletins,’ issued by the Department of Agriculture at Washington and the various State Experimental Stations, give full information on the culture of the plant and the treatment of its diseases.

Alfarabi, an eminent Arabian philosopher of the 10th century, was a native of Farab, in Asia Minor, his proper name being Abu Nasr Mohammed ben Mohammed ben Tarkhan; died at Damascus in 950. His works consist of treatises on different parts of the Aristotelian philosophy. He excelled in music and philology as well as in philosophy; and one of his most famous works is a kind of encyclopædia, in which he gives a brief account and definition of all branches of science and art. The manuscript of this is in the Escurial. His works were printed at Paris in 1638.

Alfieri, Vittorio, Count: b. Asti, in Piedmont, in 1749, of a rich and distinguished family. His early education was very defective, like that of most men of his rank and country at that time. He died 8 Oct. 1803. At the age of 16 he joined a provincial regiment which was only called together a few days during the year. For some years he led a restless and dissatisfied life, traveling in Italy, France, England, Holland, and then through the countries of northern Europe. He next left the military service, and driven by ennui tried among many other things to write dramatic poetry, and met with great success, his first play, ‘Cleopatra,’ put on the stage in 1775, being received with general applause. He now determined at the age of 27 years to devote all his efforts to attaining a position among writers of tragic poetry. Sensible of his deficiencies, he went to work zealously to educate himself. In seven years he composed 14 tragedies, studied Latin and Tuscan, and even, in his 48th year, made himself master of Greek. At Florence he became intimate with the Countess of Albany, wife of Prince Charles Edward Stuart, a daughter of the House of Stolberg. His passion had the effect of stimulating him to strive more earnestly after poetic fame. To continue his labors in a free and independent manner, he broke the last tie that bound him to his country; and making over all his fortune to his sister, save a moderate income for himself, he lived by turns in Florence and Rome. Prince Charles now dying, Alfieri married his widow, and changed his places of abode to Alsace and Paris. He was at Paris when the Revolution broke out, but after 10 Aug. 1792, returned to Florence. In the troubles of that stormy time he lost his books and the greater part of the complete editions of his tragedies, published by Didot in five volumes. He worked hard to the day of his death. He was buried in the Church of Santa Croce, at Florence, between Macchiavelli and Michael Angelo, where a beautiful monument by Canova covers his remains. Alfieri's tragedies are full of lofty and patriotic sentiments, but the language is bare and stiff, and the plots barren. Nevertheless he is the first tragic writer of Italy, and has served as a model for those who have followed him. His comedies display the same faults in a yet more glaring manner. His ‘Abel’ is the most successful of all his dramatic works. This he called a *tramelogedia* — a name as novel as the work itself, which is intermediate between tragedy and opera. Besides his dramas, Alfieri composed an epic poem, lyrics, satires, and poetical translations from the ancient classics. His autobiography, a striking exhibition of his character, appeared after his death. His complete works were published at Padua in 1809–11, in 37 volumes.

Alfonsine Tables. See ALFONSO X.

Alfon'so, the name of a number of Portuguese and Spanish kings.

Alfonso I., the Conqueror, first king of Portugal, son of Henry of Burgundy, the conqueror, and first Count of Portugal: b. 1110; fought successfully against the Spaniards and the Moors; named himself king of Portugal, and was recognized as such by the Pope; d. 1185.

Alfonso I., king of Naples and Sicily. See ALFONSO V. (of Aragon).

Alfonso V., the African, king of Portugal, succeeded his father, Edward I., 1438. Conquered Tangiers; d. 1481. During his reign Prince Henry the Navigator continued the important voyages of discovery already begun by the Portuguese. Under him was drawn up an important code of laws.

Alfonso X., king of Castile and Leon, surnamed the Astronomer, the Philosopher, or the Wise: b. 1226; succeeded to the throne 1252; d. 1284. Being grandson of Philip of Hohenstaufen, son of Frederick Barbarossa, he endeavored to have himself elected emperor of Germany, and in 1257 succeeded in dividing the election with Richard, Earl of Cornwall. On Richard's death in 1272 he again unsuccessfully contested the imperial crown. Meantime his throne was endangered by conspiracies of the nobles and the attacks of the Moors. The Moors he conquered, but his domestic troubles were less easily overcome, and he was finally dethroned by his son Sancho, and died two years after, 1284. Alfonso was the most learned prince of his age. Under his direction or superintendence were drawn up a celebrated code of laws, valuable astronomical tables which go under his name (Alfonsine Tables), the first general history of Spain in the Castilian tongue, and a Spanish translation of the Bible.

Alfonso V., king of Aragon: b. 1385; d. 1458. He was the son of Ferdinand I. of Aragon, the throne of which he ascended in 1416, ruling also over Sicily and the island of Sardinia. Queen Joanna of Naples had promised to make him her heir, but at her death in 1435 had left her dominions to René of Anjou. Alfonso now proceeded to take possession of Naples by force, which he succeeded in doing in 1442, and reigned till his death in 1458. He was an enlightened patron of literary men, by whom, in the latter part of his reign, his court was thronged.

Alfonso XII., king of Spain. He was the only son of Queen Isabella II. and her cousin, Francis of Assisi, was born in 1857 and died in 1885. He left Spain with his mother when she was driven from the throne by the revolution of 1868, and till 1874 resided partly in France, partly in Austria. In the latter year he studied for a time at the English military college, Sandhurst, being then known as Prince of the Asturias. His mother had given up her claims to the throne in 1870 in his favor, and in 1874 Alfonso came forward himself as claimant, and in the end of the year was proclaimed by General Martinez Campos as king. He now passed over into Spain and was enthusiastically received, most of the Spaniards being by this time tired of the republican government, which had failed to put down the Carlist party. Alfonso was successful in bringing the Carlist struggle to an end (1876), and henceforth he reigned with little disturbance. He married first his cousin, Maria de las Mercedes, daughter of the Duke de Montpensier; second, Maria Christina, Archduchess of Austria, whom he left a widow with two daughters, a son (Alfonso XIII.) being born posthumously.

Alfonso XIII., king of Spain, son of Alfonso XII. and Maria Christina, daughter of Karl Ferdinand, Archduke of Austria: b. after his father's death, 17 May 1886, succeeding by his birth, being a male, his eldest sister. His mother was made queen regent during his minority. On 17 May 1902 the young king formally acceded to the throne and took the oath prescribed by the constitution, the queen regent having taken official leave of the ministry on the 12th. The United States was represented at the ceremony by special envoy. The President sent the king a cordial message.

Alford, Henry, an English poet and miscellaneous writer, philologist, critic, artist, and preacher: b. London, 7 Oct. 1810; d. in Canterbury, 12 Jan. 1871. He became Dean of Canterbury in 1856. An accomplished man, his literary work attracted attention in several departments. Besides sermons and university lectures, he wrote 'The School of the Heart, and Other Poems' (1835), his most popular volume of verse; 'The Queen's English' (1866). He was best known by his celebrated edition of the Greek New Testament (1844–52), which, incorporating the results of German Biblical scholarship, formed a landmark in New Testament study in England and America. He was the first editor of the 'Contemporary Review.'

Alfred, N. Y., a village of 756 population, in Allegany co., on the Erie R.R., 12 m. from Hornellsville. It is noted as being the headquarters in America of the Seventh-Day Baptists, and as the seat of Alfred University, a co-educational (non-sectarian) institution, organized in 1836 as a school, incorporated as a university in 1857. Professors and instructors, 26; students, 215; volumes in the library, 12,136; value of grounds and buildings, $90,000; 800 graduates; total endowment is $450,000.

Alfred, or **Aluredus, of Beverley,** chronicler: flourished 1143. His 'Nine Books of Annals or History of the British Kingdoms to 1129' is largely devoted to the fabulous history of Britain. It is of no use to the historical student, as it adds nothing to what is found in earlier authorities. The best manuscript of the work is among the Hengwet MSS., and has never been printed. Hearn printed an inferior Bodleian MS. in 1716.

Alfred the Great, king of the West Saxons, and foremost figure in early English history: b. Wantage, 849; d. and buried in Winchester, 28 Oct. 901. Separated from the mass of myth and legend that has clustered about the name of this great king, the following are the known facts of his life, or those which the best scholarship agrees upon as being well authenticated. The fifth and youngest son of Æthelwulf and Osburh, he was sent to Rome in 853, remaining there and at the court of Charles the Bold for several years. The impressions received during this Continental experience and education unquestionably helped to give him that international temper and freedom from narrow insularism which so marked him among the men of his time. Little is recorded of him during the reigns of his brothers Æthelbald and Æthelberht, but when he became next in line of succession under Æthelred (866) he was clearly second only in importance to the king himself, a fact attested by his holding the high office of *Secundarius*. In 868 he married Ealhswith, daughter of ealdorman Æthelred the Mickle. In 869 he fought against the Danes at Nottingham, and when the enemy attacked his own Wessex Alfred led the van of his brother's army. Throughout that momentous year of fighting he was easily the leading spirit, taking part in the great victory of Æscesdun (Ashdown), and the later battles of Basing and Merton. Soon after Easter, in the midst of the strife with the Danes, Æthelred died, and Alfred, then only 22 years of age, took his place on the throne. A month later he fought the last battle of the year at Wilton. A series of petty defeats, due to his lack of men, compelled him to make truce, and the withdrawal of the Danes from Wessex was bought upon the usual terms,— a payment of money. For seven years the kingdom had peace. Then the Danish power again broke upon Wessex, overrunning Somerset and Devonshire almost without opposition. About Easter a general resistance began; seven weeks later he defeated the enemy at Ethandun (Edington, Wiltshire), capturing their stronghold. This broke the assailants' spirit; a treaty was concluded with the Danish leader, Guthrum, and Alfred regained all of his own kingdom, added to it all southwestern Mercia, and established an overlordship over the lands ceded to the Danes. Alfred and Wessex became the sole English power in Britain. In 884 Guthrum, with a Danish and

Scandinavian force, landed in Kent and attacked Rochester. Alfred drove them to their ships. In 886 he occupied and fortified London, and a general submission to him seems to have followed throughout Britain. During 894–7 the Danes again proved troublesome. For two years there was fighting throughout the country, but the king with his Londoners and South-Saxons made a vigorous resistance, and the invaders, worn out, retired to the Continent. Four years later he died, survived by his wife and five children; two sons, Eadward, his successor, and Æthelward; three daughters, Æthelflæd, the Lady of the Mercians, Ælfthryth, wife of Baldwin, Count of Flanders, and Æthelgifu, Abbess of Shaftesbury.

King Alfred left behind him magnificently concrete results. He converted ill-trained, short-service levies into a thoroughly organized national army, as powerfully effective a fighting machine as it had formerly been ineffective and helpless. He was the only one of his time to realize that the Danish pirates must be fought on the sea as well as on land. He thereupon created a national fleet; built larger ships than had ever before been used for warfare; and so developed his naval force that in time it was fully able to cope with the invaders upon their own element,— the sea.

His ‹ Laws › are but a compilation of the best ones of his predecessors. His own words explain this: « I durst not venture to set down in writing much of my own, for it was unknown to me what of it would please those who should come after us.» « Those things which I met with which seemed to me rightest, those I have gathered together and rejected the others.» The importance of his work was really great, for, with the blending of the codes of Wessex, Mercia, and Kent, the conception of a national law began and the idea of separate systems of tribal customs passed away.

At Alfred's accession learning seemed dead in England. In his own person, as author and translator, he started English prose into vigorous life. His translation of Orosius' ‹ History of the World › (edition with modern English translation by Bosworth, 1851) became the one accessible handbook of English history; he translated Boetius' ‹ Consolation of Philosophy › (edition with modern English translation by S. Fox, 1864), recasting somewhat its pagan doctrines; the ‹ Pastoral Care › of Gregory the Great (text and translation by H. Sweet, 1871–2); and his English version of Beda's ‹ Ecclesiastical History › perhaps suggested a greater work. This was that unique and priceless possession of the English race, ‹ The Anglo-Saxon Chronicle,› which, without much doubt, was at his bidding put into the shape in which it has come down to us. For the years of his own reign it is a detailed contemporary narrative of the highest value. It is to his efforts, to what he preserved, what he wrote, and to what his example and support encouraged others to write, that England has a richer and earlier vernacular literature than any other Western European nation. For his title of « Great » there is no ancient authority, its use going no further back than the 17th century. He never needed it, for his countrymen and the world know no other of the name with whom it is possible to confound his.

The biography of Alfred by his friend Asser is our chief authority for the king's life. Though its authenticity has been questioned, modern scholars accept it. A Latin edition is printed in Petrie and Sharpe's ‹ Monumenta Historica Britannica › (1848), and an English translation may be found in J. A. Giles' ‹ Six Old English Chronicles › (1848). There are modern ‹ Lives › by J. A. Giles (1848; 2d ed. 1854), R. Pauli (1853), and T. Hughes (1869). Freeman's ‹ Old English History › (1883) and ‹ Norman Conquest › (1870–6) may be consulted with profit, and Stubbs' ‹ Constitutional History of England › (Vol. I.) gives the constitutional aspect of Alfred's reign. A most attractive account is to be found in the chapters of patriotic panegyric in Green's ‹ Conquest of England.›

Algæ, a term popularly restricted to marine cryptogamous plants or seaweeds, but which may be generally defined as comprehending all aquatic flowerless plants, whether growing in fresh or salt water, belonging to the class Thallophytes. The only absolute distinction between the Algæ and the remaining Thallophytes or Fungi is that the former contain chlorophyll, while the latter do not. The higher forms have stems bearing leaf-like expansions, and they are often attached to rocks by roots. A stem is most frequently absent. The plants are nourished through their whole surface by the medium in which they live. They vary in size from the microscopic diatoms to forms whose stems resemble those of forest trees, and whose fronds rival the leaves of the palm. They are entirely composed of cellular tissue, and many are edible and nutritious, as carrageen or Irish moss, dulse, etc. Kelp, iodine, and bromine are products of various species. Coulter distinguishes four groups: the blue-green algæ (*Cyanophyceæ*), green algæ (*Chlorophyceæ*), brown algæ (*Phæophyceæ*), and red algæ (*Rhodophyceæ*).

Algar'di, Alessandro, one of the chief Italian sculptors of the 17th century: b. 1602; d. 1654. He lived and worked chiefly at Rome; executed the tomb of Leo XI. in St. Peter's, and a marble relief with life-size figures over the altar of St. Leo there.

Algarotti, Francesco, äl-gä-rŏt'ē, frän-ches'kō, **Count,** Italian author: b. Venice 12 Dec. 1712; d. Pisa 3 March 1764. His ‹ Plurality of Worlds › (1733), a popular exposition for ladies of Newton's philosophy, established his fame. Till 1739 he lived much in France and became intimate with Voltaire. The study of French literature and contact with its leading representatives exercised a marked influence on his style. His contemporaries greatly respected his art judgments, and his ‹ Essays on the Fine Arts,› in Italian (Germ. tr. 1760), show keen discernment. Frederick the Great held him in high regard, created him count, and ordered a monument built to his memory in Pisa. The best edition of his works is in 17 vols., Venice, 1791–4.

Algarovill'a, the seed-pods of one or two South American trees (genus *Prosōpis*), valuable as containing much tannin

Algarve, or **Faro,** a maritime province of Portugal, extending across the southern coast of the kingdom, bounded north by the prov-

ince of Alemtejo, east by the Spanish province of Huelva, south and west by the Atlantic Ocean. It has a mountainous surface, with some fertile tracts, in which excellent oil, wine, figs, and almonds are produced, and a coast indented with good bays and harbors. Its tunny and sardine fisheries are productive. Faro is its capital. The area is 2,099 sq. m. Pop. 229,000.

Algazzali, or **Alghazzâlî, Abu Hamed Mohammed,** an Arabian philosopher, Persian by birth: b. Tûs in Khorasan in 1058 or 1059; d. 1111. He first taught theology at Bagdad, but left his chair and traveled in Syria, and lived for some time in Damascus, after which he returned to Persia and resumed teaching. The details of his life given by biographers are numerous but contradictory. He was one of the most prolific of the Arabian authors. One of his writings, called the 'Destruction of the Philosophers,' was answered by Averroes in a book entitled the 'Destruction of the Destruction.' He also wrote several moral treatises. Algazzali, as a disciple of the Sufis, was an opponent of the prevailing Aristotelian philosophy of the day, and predisposed to the mystical dogmas of emanation, to which, after a keen and critical study of philosophy, he entirely resigned himself. See Dugat's 'Histoire des Philosophes et des Théologiens Musulmans' (Paris, 1878).

Algebra, Elementary. Any determinate body of entities or symbols subject to a logically consistent system of laws of operation or combination gives rise to a theory called an algebra. Accordingly there are various algebras, as the algebra of quaternions, the algebra of logic, linear algebra, the algebra of relations, the algebra of operations or of groups, multiple algebra, etc., and two algebras may differ in respect to either content or form or both. The subject-matter of ordinary algebra, with which this writing is concerned, consists of the entities known as numbers, whether real or complex (imaginary), the interrelations and properties of the entities and the laws in conformity with which they admit of combination or operation. As appears from the definition, the use of symbols to denote the entities, relations, and operations is not essential to the conception of algebra, although to its development such use is, on grounds of economy, practically indispensable. The evolution of the number system, one may say of the number concept in its wider generality, has been very slow and very long. For an account of the historical development and for citation of its literature, the reader is referred to the article HISTORY OF ELEMENTARY ALGEBRA. On the scientific side, algebra has no more escaped the minute refinements of modern criticism than have other branches of mathematics or of science and thought in general. Speaking generally, the desideratum has been to apply the Razor of Occam to hypothesis and to deduce the doctrine from the smallest number of the simplest and most fundamental data. All mathematics, all science, originates in common sense. It has been justly said that mathematics is common sense refined, etherealized. It is the aim of this article, in so far as space limitations allow, to present the elements of algebra in that aspect, to exhibit it as growing under the stimuli of need and curiosity from a soil of common experience, as the product of powers that are universal among men.

Elementary Faculties and Notions. — Every normal person has the power to form the notions, *thing* and *things*; the notion, *thing composed of things, i.e.*, the notion of collection or assemblage (see *General Theory of Assemblages*); and the notion of *correspondence*, of associating a thing or things with a thing or things, as a name with an object. These notions are neither absolutely simple nor absolutely fundamental (possibly there are no such notions), but relatively they are very simple and very fundamental, and it will be seen that they play an all-important rôle as basis of the concept and doctrine of number.

Simple Properties of Assemblages.—For explanation of the terms element, assemblage, one-to-one correspondence, equivalence (or sameness of power) of assemblages, part and proper part, see GENERAL THEORY OF ASSEMBLAGES. Assemblages will be denoted by large Roman, elements by small Greek, letters. Departures from that rule will be such as need cause no obscurity. The questionable «notion» of assemblage of *all* things is not here admitted. Hence no A contains everything. If a thing β not in A be put in, there arises $B = A + \beta$, where $+$ (plus) denotes the introduction of β, and $=$ means that B and $A + \beta$ are the same. The inverse, removing β from B, yields $B - \beta = A$, where $-$ (minus) means such removal. The elements common to A and B constitute their *intersection*. Thus, if A is all red flowers and B is all roses, the intersection of A and B is all red roses. Any proper part B of A is the intersection of B and A. In that case, $A + B = A$; *e.g.*, all rectangles + all squares = all rectangles. If A is the intersection of B and C, then $B + C = B + (C - A)$; the parenthesis signifies that $C - A$ is to be taken as a whole; *e.g.*, all men + all Europeans = all men + (all Europeans − European men). But $(B + C) - A$ is not the same as $B + (C - A)$, for plainly (all men + all Europeans) − all European men is not the same as all men + all Europeans. If, however, B and C have no intersection and A is part of C, then $(B + C) - A = B + (C - A)$; and, if C is part of B, and A is part of C, then $B - (C - A) = (B - C) + A$. In all cases, $(A + B) + C = A + (B + C)$, $A + B = B + A$. If $A \backsim B$, *i.e.*, if A and B are equivalent, and if α is not in A and β not in B, then $A + \alpha \backsim B + \beta$. So, too, are $A - \alpha$ and $B - \beta$ if α is in A, β in B, and if $A \backsim B$.

Cardinal Number Defined.—It is essential to distinguish between power and sameness of power or equivalence. The *power* (*Mächtigkeit*) of an A is the *new* assemblage yielded by disregarding (abstracting from) both the *character* and the *order* of A's elements. (See *General Theory of Assemblages.*) The new assemblage, $\overline{\overline{A}}$, is called the (cardinal) *number* of A. The number of A is thus an *orderless* assemblage of *characterless* elements (*units*). Every A has an $\overline{\overline{A}}$; and all equivalent A's have the same $\overline{\overline{A}}$, and conversely. Hence the number $\overline{\overline{A}}$ of an A is sometimes said to be or to characterize the *class* of all assemblages equivalent to A. How many elements in A or any equivalent assemblage? *Answer:* $\overline{\overline{A}}$.

Greater and Less Cardinals.—In respect to A and B, it may happen that: (*i*) A has no proper part equivalent to B, but B has a proper part equivalent to A; (*ii*) B has no proper part

equivalent to A, but A has a proper part equivalent to B; (*iii*) A has a proper part equivalent to B and B has a proper part equivalent to A; (*iv*) neither A nor B has a proper part equivalent to the other. If one of the relations holds for A and B, it holds for A' and B' whenever $A \backsim A'$ and $B \backsim B'$. If (*iii*) or (*iv*) is valid for A and B, it follows that $A \backsim B$, thence that $\bar{\bar{A}} = \bar{\bar{B}}$, and conversely; where $=$ means that the cardinals are *equal*, or the same. If (*i*) is valid, A and B are not equivalent, $\bar{\bar{B}}$ is said to be *greater* than $\bar{\bar{A}}$, $\bar{\bar{A}}$ *less* than $\bar{\bar{B}}$; symbolically, $\bar{\bar{B}} > \bar{\bar{A}}$, $\bar{\bar{A}} < \bar{\bar{B}}$. Relation (*ii*), essentially the same as (*i*), needs no further remark. Hence any two cardinals are either equal or one is greater (or less) than the other.

Addition of Cardinals.—Suppose A and B to have no intersection. Their union, assemblage composed of all and only the elements of A and B, is denoted by (A, B). Plainly $\overline{\overline{(A, B)}}$ depends only on $\bar{\bar{A}}$ and $\bar{\bar{B}}$; for $(A, B) \backsim (A', B')$ whenever $A \backsim A'$ and $B \backsim B'$. $\overline{\overline{(A, B)}}$ is called the *sum* of the *summands*, or *addends*, $\bar{\bar{A}}$ and $\bar{\bar{B}}$; symbolically, $\bar{\bar{A}} + \bar{\bar{B}} = \overline{\overline{(A, B)}}$, an equation formally *defining addition* or *summation* of cardinals. How many things in A and B together? *Answer:* $\bar{\bar{A}} + \bar{\bar{B}}$ As a cardinal is *orderless*, addition is *commutative:* $\bar{\bar{A}} + \bar{\bar{B}} = \bar{\bar{B}} + \bar{\bar{A}}$. For the same reason, it is *associative:* $\bar{\bar{A}} + (\bar{\bar{B}} + \bar{\bar{C}}) = (\bar{\bar{A}} + \bar{\bar{B}}) + \bar{\bar{C}}$.

Multiplication.—Associate each element α of A with each element β of B. Denote the assemblage of all pairs so arising by $(A \cdot B)$. $(A \cdot B) \backsim (A' \cdot B')$ whenever $A \backsim A'$ and $B \backsim B'$; hence $\overline{\overline{(A \cdot B)}}$ is determined by $\bar{\bar{A}}$ and $\bar{\bar{B}}$; $\overline{\overline{(A \cdot B)}}$ is called the *product* of the *factors* $\bar{\bar{A}}$ and $\bar{\bar{B}}$; symbolically, $\bar{\bar{A}} \cdot \bar{\bar{B}} = \overline{\overline{(A \cdot B)}}$, *definition* of multiplication of the *multiplicand* $\bar{\bar{A}}$ by the *multiplier* $\bar{\bar{B}}$. A single β taken with each α yields an assemblage A' of pairs such that $\bar{\bar{A'}} = \bar{\bar{A}}$. Each β gives such an A'; in all there are $\bar{\bar{B}}$ such A''s; the union of these is $(A \cdot B)$; hence $\bar{\bar{A}} \cdot \bar{\bar{B}} = \bar{\bar{A}} + \bar{\bar{A}} + \ldots$ where there are $\bar{\bar{B}}$ summands. Hence *multiplication is summation of equal addends.* A cardinal number being orderless, it readily appears that multiplication of cardinals is: *commutative*, $\bar{\bar{A}} \cdot \bar{\bar{B}} = \bar{\bar{B}} \cdot \bar{\bar{A}}$; *associative*, $\bar{\bar{A}} \cdot (\bar{\bar{B}} \cdot \bar{\bar{C}}) = (\bar{\bar{A}} \cdot \bar{\bar{B}}) \cdot \bar{\bar{C}}$; and *distributive*, $\bar{\bar{A}} \cdot (\bar{\bar{B}} + \bar{\bar{C}}) = \bar{\bar{A}} \cdot \bar{\bar{B}} + \bar{\bar{A}} \cdot \bar{\bar{C}}$; where, *e.g.*, $(\bar{\bar{B}} \cdot \bar{\bar{C}})$ means that the product within ( ) is multiplier of $\bar{\bar{A}}$.

Involution.—The continued product of $\bar{\bar{B}}$ equal factors $\bar{\bar{A}}$ is denoted by $\bar{\bar{A}}^{\bar{\bar{B}}}$; *i.e.*, $\bar{\bar{A}} \cdot \bar{\bar{A}} \cdot \bar{\bar{A}} \ldots = \bar{\bar{A}}^{\bar{\bar{B}}}$. Here $\bar{\bar{B}}$ is named *exponent* of $\bar{\bar{A}}$. The continued multiplication of equal factors is called *involution*, and the process of obtaining $\bar{\bar{A}}^{\bar{\bar{B}}}$ is described as *raising* $\bar{\bar{A}}$ *to the* $\bar{\bar{B}}$*th power.* From the definitions involved, the following relations, *laws of exponents*, are found: $\bar{\bar{A}}^{\bar{\bar{B}}} \cdot \bar{\bar{A}}^{\bar{\bar{C}}} = \bar{\bar{A}}^{\bar{\bar{B}} + \bar{\bar{C}}}$; $\bar{\bar{A}}^{\bar{\bar{C}}} \cdot \bar{\bar{B}}^{\bar{\bar{C}}} = (\overline{\overline{A \cdot B}})^{\bar{\bar{C}}}$; $(\bar{\bar{A}}^{\bar{\bar{B}}})^{\bar{\bar{C}}} = \bar{\bar{A}}^{\bar{\bar{B}} \cdot \bar{\bar{C}}}$.

Ordinary Cardinals.—If A contains but a single thing α, $\bar{\bar{A}}$ is named *one*, denoted by 1; *i.e.*, $\bar{\bar{A}} = 1$. The symbol $\equiv$ between two assemblage symbols means that these denote the same assemblage. Let $A_1 \equiv (A, \alpha_1)$, union of A, or α, and another thing α_1. Then $\bar{\bar{A}}_1$ is denoted by 2 and named *two*. In like manner $\bar{\bar{A}}_2$ is named *three* and denoted by 3, in case $A_2 \equiv (A_1, \alpha_2)$, α_2 being different from α and α_1. Continuation of the process yields the series 1, 2, 3, 4, . . . , ν, . . . , of symbols, and the corresponding series, *one, two, three, four*, . . . , of names, of the numbers $\bar{\bar{A}}$, $\bar{\bar{A}}_1$, $\bar{\bar{A}}_2$, $\bar{\bar{A}}_3$, . . . Each of these numbers has a *next after* it and, except 1, a *next before* it. It admits of *proof* that the numbers of the series have the properties: no two of them are equal; each is greater than any preceding one, less than any following one; if ν' is next before ν, $\nu = \nu' + 1$; there is no cardinal number at once $> \nu$ and $< \nu + 1$; no number of the series is greater than every other; there is a least cardinal, viz., 1. Any word with its predecessors of the *count* word series, one, two, . . . , constitute an assemblage equivalent to that whose cardinal the word names; hence, *in counting, the word last used tells the number of things counted, no matter in what order.*

Distinction of Finite and Infinite.—If $\bar{\bar{A}} + 1 = \bar{\bar{A}}$, $\bar{\bar{A}}$ is said to be *infinite* or *transfinite*; in the contrary case, *finite*. Denote by N the assemblage: 1, 2, 3, . . . , ν, . . . Every element of N is a *finite* cardinal, and every finite cardinal is in N. But $\bar{\bar{N}}$ itself is *transfinite* for, $(N, \alpha) \backsim N$, where α is not in N: we may pair α with 1, 1 with 2, . . . Hence $\overline{\overline{(N, \alpha)}}$, or $\bar{\bar{N}} + 1$, $= \bar{\bar{N}}$; *i.e.*, the number of the *part* N is equal to the number of the *whole* (N, α). The so-called self-evident truth, the whole is greater than any of its parts, is generally false. It is always valid for finite assemblages, never for infinites. It serves as *discriminant* of the two classes.

The foregoing sketch will serve to indicate briefly something of the simplicity, depth, and generality of the modern doctrine of the cardinal number.

Need of Generalization of Number Concept.—The numbers in N, the finite cardinals, constitute the foundation of arithmetic and algebra. These numbers are necessary but not sufficient. They afford answers to hosts of questions about themselves, but at the same time they stimulate curiosity to ask other hosts that they cannot answer. What number added to itself gives 4? What number multiplied by itself gives 9? For these N has the answers. Not so, however, if we replace 4 and 9 by 5 and 10. If a and b are any two numbers in N, we may

ask: what is their sum? $a+b=?$ Their product? $a\cdot b=?$ (or $ab=?$ or $a\times b=?$) What is the ath or bth power of b or a? $b^a=?$ $a^b=?$ N contains the answer to every such question of addition or multiplication or involution. But the *inverse* operations, subtraction, division, and evolution, yield questions about the cardinals that the latter do not suffice to answer. To answer all such questions, to render the inverse operations always possible, it is necessary to invent or create new *entities* to meet the demands. These entities, once created, constitute a new assemblage. The union of this with N is then a new *enlarged* assemblage or domain of numbers.

Subtraction, Creation of Negatives.—If A is a finite assemblage, B a proper part of A, and R the assemblage left on suppressing B, then, if $\overline{\overline{A}}=a$, $\overline{\overline{B}}=b$, $\overline{\overline{R}}=c$, we write $c=a-b$, formal definition of *subtraction* of *subtrahend* b from *minuend* a, yielding the *difference* c, or $a-b$. From this definition and that of addition, it follows that $c+b=a$. As A is finite and B is proper part of A, $a>b$. What if $B\equiv A$? Then R is *empty*, and c is not in N. We write *zero* (0) for c, so obtaining $a-a=0$. Calling zero a number and treating it like the cardinals, we have $a+0=a$, $a-0=a$. Consider the relation $c=a-b$. If $b>a$, the relation has no *defined* meaning, for c is neither zero nor in N. We *give* it a meaning. Note that c is to be such that $c+b=a$. Let n be any number in N, and define $\bar{n}$ to be such that $n+\bar{n}=0$. The number $\bar{n}$ is called a *negative* integer, usually written with the bar in front; thus, $-n$; in contradistinction, n is called *positive*, and often written $+n$. To every positive integer corresponds a negative. The sum of any such pair is zero. If $c=a-b$, where $b>a$, c now has definite meaning: c is in N', the assemblage of negative integers. For example, if $c=2-7$, $c=-5$, or $\bar{5}$, for $c+7=2$, $\bar{5}+5+2=0+2=2$.

The *growth* of the number concept is noteworthy: first, the numbers in N; next, zero giving the assemblage $E\equiv(N, 0)$; then the negatives, giving $E'\equiv(E, N')$, which suffice to answer every subtraction question about finite cardinals, or positive integers.

Extension of Old Operations to New Numbers.—Curiosity grows by what it feeds upon. Having secured the invention of zero and negative integers, it asks: how operate on them? How combine any two of the numbers now in hand, whether new or old? For the new numbers new rules, any logically consistent set, might be adopted. So would result *another* algebra. That would be lawful but not expedient. Expedience counsels, though necessity does not compel, the retention and extension of the old rules; as, $a+b=b+a$, etc. Expedience prevails. The consequences, though *formally* obtainable, are for beginners best found by some concrete device, as the plotting of the numbers on the a right line:

$$\ldots -3 \quad -2 \quad -1 \quad 0 \quad +1 \quad +2 \quad +3 \ldots$$

For addition and subtraction the new problems are:

(1) $-5+2=?$ $\qquad -a+b=?$
(2) $+2+(-5)=?$ $\qquad +b+(-a)=?$
(3) $-2+(-5)=?$ $\qquad -b+(-a)=?$
(4) $-2-(+5)=?$ $\qquad -b-(+a)=?$
(5) $+2-(-5)=?$ $\qquad +b-(-a)=?$
(6) $-2-(-5)=?$ $\qquad -b-(-a)=?$

Zero is obviously either (both) positive or (and) negative. Old question: $5+2=?$ $a+b=?$ Answer by stepping: begin at 5 or a, step rightward, 2 or b steps: old rule. To answer (1), follow old rule: begin at -5, etc. Hence, $-5+2=-3$; but by old rule, commutative law, $-5+2=2+(-5)$, hence $2+(-5)=-3$; but by definition, $2-5=-3$, hence $2+(-5)=2-5$: the reasoning is *independent* of the particular integers used; hence $-a+b=b+(-a)=b-a$; *i.e.*, to add a negative is to subtract corresponding positive. Analogously one may find: $-b+(-a)=-b-a=-(b+a)$; $b-(-a)=b+a$; $-b-(-a)=-b+a=-(b-a)$. For multiplication, solutions of the like problems are similarly obtainable: $(-a)\cdot b=b\cdot(-a)=-(a\cdot b)$; $(-a)\cdot(-b)=(-b)\cdot(-a)=(a\cdot b)=ab$; $0\cdot b=b\cdot 0=0\cdot(-b)=(-b)\cdot 0=0=0\cdot 0$. If a be in N or N', and if $a=2\cdot b$, where b is in N or N', a is called *even*; otherwise, *odd*. If a is in N' and b in N, then, from the definitions involved, it is seen that a^b is in N or in N' according as b is even or odd; symbolically, $(-a)^b=+a^b$, if b is even, and $(-a)^b=-a^b$, if b is odd. In particular, $(-1)^b=1$ or -1 according as b is even or is odd: $(-a)^b=(-1)^b a^b$, b even or odd. Extension of the old involution notion and its rules to the new numbers yields new symbols such as a^0, $(-a)^0$, a^{-b}, $(-a)^{-b}$, . . . , and corresponding formal relations such as $(-a)^b\cdot(-a)^{-c}=(-a)^{b-c}$, . . . ; of which the meaning in other terms will appear at a subsequent stage.

Operation of Division, the Concept of Fraction.—The numbers in E' suffice to answer all addition, subtraction, and multiplication questions about themselves, but other questions remain, unanswerable in such terms. E' does not enable us to answer the inverse of every multiplication question even about the positive integers, much less about all the numbers in E'. The inverse of multiplication is named *division*. Given a and b, any numbers of E', multiplication asks: $a\cdot b=?$ The answer is in E'. Given a and c, of E', division asks: $a\cdot(?)=c$; for examples, $4\cdot(?)=8$, $4(?)=9$. In general E' fails to answer. To meet the demand, a new *entity*, named *fraction*, to be thenceforth regarded as a number, is created by the definition: $a\cdot\frac{c}{a}=c$, or $\frac{c}{a}\cdot a=c$. The fraction $\frac{c}{a}$ is often written c/a or $c:a$ or $c\div a$; c is *numerator* or *dividend*, a is *denominator* or *divisor*, c and a are the *terms*; c is said to be divided by a, and $\frac{c}{a}$ is the *quotient* of c by a, or *ratio* of c to a. Plainly, the definition fails to determine $\frac{c}{a}$, when $a=0$; for if $\frac{c}{a}=b$, $c=b\cdot a$, but $b\cdot 0=n\cdot 0$. Hence *zero* is *not* admissible as *denominator* (divisor).

Rational Numbers.—The positive and negative integers, zero, and the fractions are together said to constitute the assemblage of *rational* numbers. Obviously all the rationals are (conceivable as) fractions; for, if a be an integer or zero, $a\cdot 1=a$, but $\frac{a}{1}\cdot 1=a$, whence $a=\frac{a}{1}$. The rules for combination of rationals are consistent extensions of those found for the special rationals composing E'. As to signs:

$$+\frac{+a}{+b}=+\frac{-a}{-b}=-\frac{+a}{-b}=-\frac{-a}{+b},$$

$$-\frac{+a}{+b} = +\frac{-a}{+b} = +\frac{+a}{-b} = -\frac{-a}{-b};$$

$$\left(+\frac{a}{b}\right)\cdot\left(-\frac{c}{d}\right) = -\left(\frac{a}{b}\cdot\frac{c}{d}\right),$$

and so on as for integers. Formulæ, or rules, for addition, subtraction, multiplication, and division of rationals (including those not in E') are readily obtained. For example, $\frac{a}{b}\cdot\frac{c}{d}=$? Let $\frac{a}{b}\cdot\frac{c}{d}=x$; then by the definitions involved and the commutative, distributive, and associative laws, one has:

$$\left(\frac{a}{b}\cdot\frac{c}{d}\right)\cdot bd = x\cdot bd;\quad \left(\frac{a}{b}\cdot b\right)\left(\frac{c}{d}\cdot d\right) = x\cdot bd;$$

$$ac = x\cdot bd;\quad \frac{ac}{bd}\cdot bd = ac;\quad \frac{ac}{bd}\cdot bd = x\cdot bd;$$

$\frac{ac}{bd}=x$; $\frac{a}{b}\cdot\frac{c}{d}=\frac{ac}{bd}$, rule for multiplication. Again,

let $\quad \frac{a}{b}+\frac{c}{d}=x$; then $\left(\frac{a}{b}+\frac{c}{d}\right)\cdot bd = x\cdot bd$;

$$\frac{a}{b}bd+\frac{c}{d}bd = x\cdot bd;\quad ad+bc = x\cdot bd;$$

$$\frac{ad+bc}{bd}\cdot bd = ad+bc;\quad \frac{ad+bc}{bd}\cdot bd = x\cdot bd;$$

$\frac{ad+bc}{bd}=x$; $\frac{a}{b}+\frac{c}{d}=\frac{ad+bc}{bd}$, rule for addition (including subtraction). Analogously may be found that $\frac{a}{b}\div\frac{c}{d}=\frac{a}{b}\cdot\frac{d}{c}$; *i.e.*, division is convertible into multiplication. The *absolute* or *numerical* value of a rational is its value regardless of sign; *e.g.*, the numerical value of -4 is 4. Plainly, $\frac{a}{b}=\frac{ad}{bd}$, $\frac{c}{d}=\frac{cb}{db}$; numerically, $\frac{a}{b}$ is greater than, equal to, or less than $\frac{c}{d}$ according as the like relation subsists between ad and bc. In respect to numerical value, there is a rational and hence an infinity of rationals between every two numerically unequal rationals. Any positive is said to be *algebraically* greater than any negative.

Evolution, Radicals, Surds.—The sum, difference, product, or quotient (division by zero being excluded) of any two rationals is a rational. As to these operations, the domain of rationals is closed. Not so, however, if we admit *evolution*. Let $\frac{a}{b}$ be any rational, and n a positive integer. Involution asks: $\left(\frac{a}{b}\right)^n=$? The answer is a rational. But, n being a positive integer and $\frac{c}{d}$ being rational, evolution inverts the question and asks for a number k such that $k^n=\frac{c}{d}$. In general no rational answers. For example, no rational satisfies the relation $k^2=-1$ or the relation $k^2=2$. To meet such needs a new entity, $\sqrt[n]{r}$, r being rational and n a positive integer, is created by the definition: $(\sqrt[n]{r})^n=r$. The entity or symbol $\sqrt[n]{r}$ is named *radical*, or *nth root* of r. The previously unanswerable question is now answerable: $k=\sqrt[n]{\frac{c}{d}}$. If n is even and r negative, $\sqrt[n]{r}$ is called *imaginary* (see THEORY OF FUNCTIONS OF COMPLEX VARIABLE); in particular, $\sqrt[2]{-1}$, or simply $\sqrt{-1}$, denoted by i, is called imaginary *unit*. If n is odd and r negative, or if n is odd or even and r positive, $\sqrt[n]{r}$ is said to be *real*. Obviously any rational is conceivable under the form $(\sqrt[n]{r})^n$; *e.g.*, $3=(\sqrt{3})^2=(\sqrt[3]{3})^3$, etc. Often, too, $\sqrt[n]{r}$ is rational; *e.g.*, $\sqrt{4}=2$, $\sqrt[3]{27}=3$. If $\sqrt[n]{r}$ is real but not a rational, it is named *surd* of *order n*; *e.g.*, $\sqrt{2}$ is a surd of 2d order. That $\sqrt{2}$ is *not* rational is readily shown. It is plainly no integer. If, then, it is rational, $\sqrt{2}=\frac{a}{b}$, where $b>1$ numerically and $\frac{a}{b}$ is in its *lowest terms*, *i.e.*, a and b are *prime* to each other*, *i.e.*, have no common factor except 1 or -1; then $2b=\frac{a^2}{b}$, an integer equal to a non-integer.

Generalized Exponents.—By means of the new numbers, zero, negatives, fractions, radicals (including surds), the notion of exponent, defined for positive cardinals, admits of generalization to include such forms as a^0, $a^{\frac{3}{4}}$, a^{-2}, etc. The question is: What do such forms signify? In themselves they are meaningless. It is man who gives them meaning, subject to the condition that his algebra shall be self-consistent. It will be sufficient to indicate the process. For (positive) cardinals, $a^m\cdot a^n=a^{m+n}$. This law is *imposed* in case a is any number, new or old. Similarly for $(a^m)^n=a^{mn}$ and $a^m\cdot b^m=(ab)^m$. It readily appears that $\frac{a^m}{a^n}=a^{m-n}$, where $m>n$ and a is not zero. What signifies $a^{\frac{1}{b}}$, b being a positive integer? Assume that $a^{\frac{1}{b}}$ satisfies the law, $a^m\cdot a^n=a^{m+n}$. Then $a^{\frac{1}{b}}\cdot a^{\frac{1}{b}}\cdot\ldots$ (to b factors) $=a^{\frac{1}{b}+\frac{1}{b}+\ldots\text{(to } b \text{ terms)}}=a^{\frac{b}{b}}=a^1=a$; *i.e.*, $\left(a^{\frac{1}{b}}\right)^b=a$, but $\left(\sqrt[b]{a}\right)^b=a$, hence $a^{\frac{1}{b}}=\sqrt[b]{a}$; *e.g.*, $\sqrt{2}=2^{\frac{1}{2}}$, $\sqrt[5]{-3}=(-3)^{\frac{1}{5}}$. It similarly follows that $a^{\frac{b}{c}}=\sqrt[c]{a^b}=\left(\sqrt[c]{a}\right)^b$. In like manner, $a^0\cdot a^b=a^{0+b}=a^b$, but $1\cdot a^b=a^b$, hence $a^0=1$. Once more, let b be a positive integer or fraction, then $a^{-b}\cdot a^b=a^{b-b}=a^0=1$; multiplying by $\frac{1}{a^b}$, $a^{-b}=\frac{1}{a^b}$. It then requires and admits of proof that the exponent laws hold good in case the exponents are any rationals. The case where the exponents are not rationals remains for consideration, requiring another order of ideas of which some account follows.

Irrational Numbers.—It has been seen that the surds are irrational. They may be defined by a more general method, available for the

* See Theory of Numbers.

definition of additional irrationals. For example, the arithmetic process (here assumed) for extracting square root yields for $\sqrt{2}$ the endless decimal 1.41421 ... Consider the two endless sequences of rationals: (1) 1, 1.4, 1.41, 1.414, 1.4142, ...; (2) 2, 1.5, 1.42, 1.415, 1.4143, ... Every number of (1) is $<$ every number of (2); it is possible to find in (1) a number m and in (2) a number n such that $n-m<r$, r being a positive rational small at will, chosen in advance. Hence (1) and (2) are said to define, by approaching near at will, some *Definite*, d, as their common *limit*. Plainly d is in neither (1) nor (2). What is d? The sequences (3) and (4) obtained by squaring the numbers of (1) and (2) are clearly related to 2 as (1) and (2) to d; hence d is $\sqrt{2}$. That is, the *irrational* $\sqrt{2}$ is *definable* as *limit* of *rational* sequences. Compare (see ELEMENTARY PURE GEOMETRY) the definition of π, (irrational) ratio of circumference to diameter of circle. The defining method just exemplified is, in generality, as follows: Let A and B be any two sequences of rationals such that: (*i*) every number of B is $>$ every one of A; (*ii*) given any positive rational r, small at will, there are in A and B numbers a and b such that $b-a<r$. Then A and B have a common *limit*, some *definite*, d. Such d may be rational, as 2 in case of (3) and (4). If d be not a rational, it is named *irrational number*. The rationals and the irrationals together constitute the assemblage of *real* numbers (see THEORY OF THE REAL VARIABLE). If a and b are real and $i=\sqrt{-1}$, numbers of the form $a+ib$ are called *complex* (see THEORY OF THE COMPLEX VARIABLE). The complex numbers $a+bi$ and $a-bi$ are said to be *conjugate*. It is found that the real and complex numbers obey the formal laws of operation that control combination of rationals.

Terms, Expressions, Factors, etc.—In algebra numbers, real or complex, are commonly called *quantities*. Any lawful combination, however complicate, of number symbols represents a number or quantity, and is named algebraic *expression*, as 5, $3a$, $\sqrt{7}\,(a^{\frac{1}{2}}-\sqrt[3]{x^2})$, $\dfrac{(m-n)^{\frac{a}{b}}}{x-z\sqrt{w}}$. The parts of an algebraic expression that are connected by the sign + or − are called *terms*. Two or more terms enclosed in *parentheses* () or *brackets* [] or *braces* {} or written under a *vinculum* $\overline{\quad}$ are treated as a whole; thus, $2-(4+6)=2-10$, $3\times\overline{7-5}=3\times 2$, $x-[y-\{z-(x-y-z)\}]=x-[y-\{z-(x-y+z)\}]=x-[y-\{z-x+y-z\}]=x-[y+x-y]=x-x=0$. An expression of more than one term is a *polynomial* or *multinomial*. Expressions of one, two, three terms are respectively *monomial*, *binomial*, *trinomial*; thus, $a-(b-c)$ is binomial, though its equivalent, $a-b+c$, is trinomial. The term fraction is extended to any expression in the *form* of a fraction (as above defined). An expression may be *integral* as to some of its symbols and *fractional* as to others; thus $\dfrac{(x^2-y^2)w^{-4}}{z^3}$ is integral as to x and y, but fractional as to z and w. The like distinction holds in respect to *rational* and *irrational*: thus $x^{\frac{1}{2}}y^2-\sqrt[3]{z^2}$ is rational as to y, irrational as to x and z. In the indicated product of two or more symbols, as $4\times\frac{1}{2}abx$, any partial product is the *coefficient* of the complementary product; thus 4 and $\frac{1}{2}abx$ are coefficients of each other; similarly, for $4\times\frac{1}{2}$ and abx, for $4\times\frac{1}{2}x$ and ab, etc. An expression that is rational and integral as to some symbol, as x, is said to be of degree n in that symbol if its greatest exponent in any term is n; thus $a^2x^5+ba^3x^3-4xa^6+1$ is of degree 5 in x, of degree 6 in a, and of degree 1 in b. An expression rational and integral in two or more symbols is said to be of degree s in those symbols (together) if s is the largest sum of the exponents of those symbols in any term; thus $a^2b^3c-5a^3b^4c^2-7b^2c^3$ is of degree 9 in a, b, c (together). In general, each of two or more expressions is called a factor of their product. In this general sense, $a^{\frac{1}{2}}$ and $a^{\frac{3}{2}}$ are factors of a^2, and so, too, are $\dfrac{a^3}{b}$ and $\dfrac{b}{a}$. In a more restricted sense, the factors of an expression rational and integral as to some letter must themselves be rational and integral as to that letter; thus some factors of a^2b-a^3b are a, a^2, b, ab, a^2b, $1-a$, for division by any of these yields a quotient rational and integral as to a and b. In such cases, factors of lowest degree in any symbol are called simple factors (in that (symbol). A factor of two or more expressions is called a *common factor* of them. The common factor of highest degree is called the ***highest common factor*** (*H.C.F.*); thus the *H.C.F.* of a^3b^2 and a^2b^3 is a^2b^2; of a^2-b^2 and $ac+bc$, it is $a+b$. Every expression is a *multiple* of its factors. A multiple of two or more expressions is called a *common multiple* of them; it is their *lowest common multiple* (*L.C.M.*) if it is the common multiple of lowest degree; thus, the *L.C.M.* of a ab^2c^2 and a^2bc^3 is $a^2b^2c^3$; of $(x-a)(x-b)^2(x-c)^3$ and $(x-a)^4(x-b)(x-c)$ it is $(x-a)^4(x-b)^2(x-c)^3$. It is readily proved that the product of two expressions is equal to that of their *H.C.F.* and *L.C.M.* If E is any algebraic expression, then $E^2, E^3, \ldots, E^n$ are respectively the second, third, ..., nth powers of E, and E is the *square*, *cube*, ..., nth root respectively of $E^2, E^3, \ldots, E^n$. In particular, E^2 and E^3 are the square and the cube of E. Thus ax^2 is the square root of a^2x^4, $\dfrac{a}{b}$ is the cube root of a^3b^{-3}, $x^{\frac{1}{2}}-y^{\frac{1}{2}}$ is the square root of $(x^{\frac{1}{2}}-y^{\frac{1}{2}})^2$, or $x+y-2x^{\frac{1}{2}}y^{\frac{1}{2}}$.

Ratio, Proportion, Variation.—The fraction $\dfrac{a}{b}$ is the *ratio* of a to b, often written $a:b$, of which a is *antecedent* and b is *consequent*. If $a=\dfrac{x}{y}$ and $b=\dfrac{z}{w}$, then $a:b=\dfrac{xw}{yz}$. A ratio is *commensurable* or *incommensurable* according as it is or is not a rational number; thus, 2:5 is commensurable, but $\sqrt{2}:1$, ratio of diagonal to side of square, is incommensurable. Plainly, ratio theory is fraction theory. It is easily proved that if $\dfrac{a}{b}=\dfrac{c}{d}=\dfrac{e}{f}=\ldots$, then $\dfrac{a+c+e+\ldots}{b+d+f+\ldots}=\dfrac{a}{b}$, unless $b+d+f+\ldots=0$. If $\dfrac{a}{b}=\dfrac{c}{d}$, a, b, c, and d, taken in order, are *in proportion*, often written $a:b::c:d$, or $a:b=c:d$, a and d being the *extremes* and b and c the *means*. In such case $ad=bc$, and conversely. If $a:b=b:c$, *i.e.*, if $b^2=ac$, b is a *mean proportional* to a and c, and

c is a *third proportional* to a and b. If $a:b=c:d$, then $a+b:b=c+d:d$, $a-b:b=c-d:d$, whence $a+b:a-b=c+d:c-d$; *i.e.*, a, b, c, d are in proportion by *composition*, by *division*, and by both. A quantity x varies *directly* as y, symbolically $x \propto y$, if the ratio of every two values of x is equal to the ratio of the corresponding y values. If $x \propto 1:y$, x varies *inversely* as y. If $x \propto yz$, x varies as y and z *jointly*. Examples: if x is distance traveled and y is rate, $x \propto y$; if x is volume of given mass of gas (at constant temperature) and y is pressure on it, $x \propto 1:y$ (Boyle's Law); if x is the area of triangle and x and z are base and altitude, $x \propto yz$. If $x \propto y$, $x=cy$, where c is some constant; if $x \propto 1:y$, $x=c:y$; if $x \propto yz$, $x=cyz$, if $x \propto y$ and $\propto 1:z$, $x=cy:z$; if $x \propto y$ and $y \propto z$, $x \propto z$, $x+y \propto z$, $x-y \propto z$, $\sqrt{xy} \propto z$; if $x \propto y$ and $z \propto w$, $xz \propto yw$; if $x \propto y$, $x^k \propto y^k$, k any exponent; if $x \propto y$ when z is constant, and $x \propto z$ when y is constant, then $x \propto yz$ when y and z both vary. It is seen that *variation* is a kind of generalized doctrine of proportion.

The Notion and Notation of Function.—A quantity which may take different values is a *variable.* Two variables so related that to a value of either there corresponds one or more values of the other are called functions of each other (see INFINITESIMAL CALCULUS). Any algebraic expression is a function of the symbols it involves, and conversely; for example, $2x^2+3$ is a function of x, and conversely. A function of a symbol as x is often denoted by the symbol $f(x)$ or $F(x)$ or $\phi(x)$ or the like and read f-function of x, and so on. If $f(x)=2x^2-4$, then $f(0)=-4$, $f(-1)=-2$, $f(a)=2a^2-4$, etc. The function symbol has reference to the *form* of the function, and in the same argument or discussion the same symbol may not be used for two different functions. Of great importance are the integral (entire) polynomials, of which the general form for a single variable x is $f_n(x) \equiv a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x + a_n$. The coefficients a_0, a_1, ..., a_n are regarded as arbitrary constants. Accordingly $f_1(x) \equiv a_0x + a_1$, said to be *linear* or of first degree; $f_2(x) \equiv a_0x^2 + a_1x + a_2$, the general *quadratic* expression or expression of second degree; $f_3 \equiv a_0x^3 + \ldots + a_3$, the general *cubic*, $f_4(x) \equiv a_0x^4 + \ldots + a_4$, the general *biquadratic*, etc. The *general* expressions become *particular* or *special* on assigning specific (numerical) values to the (literal) coefficients. In any $f_n(x)$ any value may be given to x, the corresponding value of $f_n(x)$ is then determined. The inverse problem of determining all values of x for which $f_n(x)$ shall have a prescribed value is far more difficult. A value of x for which $f_n(x)$ is zero is said to cause $f_n(x)$ to *vanish.* To every expression $f_n(x)$ corresponds an equation, $f_n(x)=0$, of 1st, 2d, ..., nth degree, according as $n=1, 2, \ldots, n$. The equation imposes a *condition* on x, restricting its variability, allowing it only such values as make $f_n(x)$ vanish. (The variable in an equation is called the *unknown quantity.*) Any such value is a *root* of the equation. The equation $f_n(x)=0$ has n and only n roots (see THEORY OF EQUATIONS). To *solve* an equation is to find its roots. A linear equation $a_0x+a_1=0$ has one root, $\frac{-a_1}{a_0}$, and it may always be found by adding $-a_1$ to both *members* a_0x+a_1 and 0 and then dividing the sums by a_0. The result of the addition is the equation $a_0x = -a_1$. Obviously any term may be *transposed* from either member of an equation to the other if at the same time the *sign* of the term be reversed. Presently we shall see how to solve *quadratic*, *cubic*, and *biquadratic* equations.

Factor and Remainder Theorems.—Obviously $f_n(x)$ may contain a factor of the form $x-a$; *e.g.*, $x-2$ is a factor of x^2-4. If $f_n(x)$ has $x-a$ for factor, then $f_n(x) \equiv (x-a)Q$, where Q is the quotient of $f_n(x)$ divided by $x-a$. Hence under the supposition $f_n(x)$ vanishes when a is put for x. The converse is the *factor theorem*: If $f_n(x)$ vanishes on replacing the variable x by a number a, then $x-a$ is a factor of $f_n(x)$. Proof: divide $f_n(x)$ by $x-a$ until the remainder R does not contain x. Then $f_n(x) \equiv (x-a)Q+R$; put a for x, then $f_n(a) \equiv (0-0)Q+R$, but $f_n(a)=0$, hence $R=0$, hence $f_n(x) \equiv (x-a)Q$. At the same time is proved the *remainder theorem*: Division of $f_n(x)$ by $x-a$ yields $f_n(a)$ for remainder. By the factor theorem it is seen that x^n-a^n is divisible by $x-a$, for on putting a for x, $x^n-a^n = a^n-a^n=0$. Put a for x in x^n+a^n; the result is not zero; hence $x-a$ is not a factor of x^n+a^n. If n is odd, $x+a$ is a factor of x^n+a^n for $(-a)^n+a^n=0$ for n odd.

The Quadratic Equation.—The general quadratic equation $ax^2+bx+c=0$ can be solved as follows: The roots of an equation are not altered by adding a constant to both members or by multiplying both by a constant. Dividing both members by a, then adding $\frac{b^2}{4a^2}-\frac{b^2}{4a^2}$ to the left member, we obtain $\left(x+\frac{b}{2a}\right)^2-\left(\frac{b^2-4ac}{4a^2}\right)=0$; factoring,

$$\left\{x+\frac{b}{2a}+\frac{1}{2a}\sqrt{b^2-4ac}\right\}\left\{x+\frac{b}{2a}-\frac{1}{2a}\sqrt{b^2-4ac}\right\}=0.$$

If the product of two or more integral factors is zero, one of them must be zero and the equation is *satisfied* if any one of them is zero. Hence the roots of the quadratic are the roots of the linear equations obtained by equating to zero the foregoing factors. The roots r_1 and r_2 are:

$$r_1=\frac{1}{2a}(-b+\sqrt{b^2-4ac}),\ r_2=\frac{1}{2a}(-b-\sqrt{b^2-4ac}).$$

Thus it is seen that every quadratic equation has two and but two roots. Their *sum* $r_1+r_2=-\frac{b}{a}$ and their product $r_1r_2=\frac{c}{a}$, a special case (see THEORY OF EQUATIONS) of the law connecting the roots and coefficients in the general equation $f_n(x)=0$. If the coefficients are real, the roots are both imaginary when and only when the discriminant $b^2-4ac<0$, or negative. If $b^2-4ac=0$ the roots are equal; if b^2-4ac is a perfect square, they are rational.

The Cubic Equation, Cube Roots of Unity.—Let $x^3=1$, then $x^3-1=0$; factoring left member, $(x-1)(x^2+x+1)=0$. Hence the cube roots of unity are 1, $\omega_1=\frac{1}{2}(-1+\sqrt{-3})$, $\omega_2=\frac{1}{2}(-1-\sqrt{-3})$; ω_1 and ω_2 are imaginary (complex); $\omega_1^2=\omega_2$, $\omega_2^2=\omega_1$, $\omega_1^3=\omega_2^3=1$; writing ω for ω_1, the cube roots of 1 are 1, ω, ω^2. Any number a has three cube roots, $\sqrt[3]{a}$, $\omega\sqrt[3]{a}$, $\omega^2\sqrt[3]{a}$; thus the cube roots of 8 are 2, $\omega 2$ and $\omega^2 2$. The general cubic may be written $x^3+ax^2+bx+c=0$. On

putting $y-\frac{a}{3}$ for x, the cubic becomes

$$y^3+\left(b-\frac{a^2}{3}\right)y+\left(c-\frac{ab}{3}+\frac{2a^3}{27}\right)=0,$$

or $y^3+py+q=0$ lacking the second term and called the *reduced* cubic. It is sufficient to solve the reduced cubic, for the roots of the original are then found by the relation $x=y-\frac{a}{3}$. Let $y=z-\frac{p}{3z}$, then $z^6+qz^3-\frac{p^3}{27}=0$. This is *quadratic* in z^3, yielding $z^3=-\frac{q}{2}\pm\sqrt{Q}$ $\left(\text{where } Q=\frac{q^2}{4}+\frac{p^3}{27}\right)$, $z=\sqrt[3]{-\frac{q}{2}\pm\sqrt{Q}}$, $\omega\sqrt[3]{\quad}$, $\omega^2\sqrt[3]{\quad}$. From the fact that z has six values, it must not be inferred that y has six; for the two values z_1^3 and z_2^3 of z^3 are such that $z_1^3z_2^3=-\frac{p^3}{27}$; hence the six z-values, z_1, z_2, ωz_1, ω^2z_2, ωz_2, ω^2z_1, yield but *three* y-values, corresponding to the relations $z_1z_2=\omega z_1\cdot\omega^2z_2=\omega_2z_1\cdot\omega z_2=-\frac{p}{3}$. For example, $y_1=z_1-\frac{p}{3z_1}=z_2-\frac{p}{3z_2}=z_1+z_2$. If

$$z_1=\sqrt[3]{-\frac{q}{2}+\sqrt{Q}},\quad\text{then}\quad z_2=\sqrt[3]{-\frac{q}{2}-\sqrt{Q}},$$

and the y-values are:

$$y_1=\sqrt[3]{-\frac{q}{2}+\sqrt{Q}}+\sqrt[3]{-\frac{q}{2}-\sqrt{Q}},$$

$$y_2=\omega\sqrt[3]{-\frac{q}{2}+\sqrt{Q}}+\omega^2\sqrt[3]{-\frac{q}{2}-\sqrt{Q}},$$

$$y_3=\omega^2\sqrt[3]{-\frac{q}{2}+\sqrt{Q}}+\sqrt[3]{-\frac{q}{2}-\sqrt{Q}}.$$

It can be readily shown for real p and q that one of the y's is real and the other two are conjugate imaginaries if Q be $+$, that all are real and two are equal if $Q=0$, and that all are real and distinct if Q is $-$. The last case is called *irreducible* because the root formula, involving imaginaries, is *practically* valueless. In this case the roots may be found by help of the trigonometric functions (see TRIGONOMETRY) as follows: Let $Q=-r^2\sin^2\theta$, $-\frac{1}{2}q=r\cos\theta$, then $r=\sqrt{-p^3:27}$, $\cos\theta=-\frac{1}{2}q:\sqrt{-p^3:27}$. The value of θ may be found by trigonometric table. Hence

$$\sqrt[3]{-\tfrac{1}{2}q+\sqrt{Q}}=\sqrt[3]{r\cos\theta+ir\sin\theta}$$
$$=\sqrt[3]{r}\{\cos\tfrac{1}{3}(\theta+2k\pi)+i\sin\tfrac{1}{3}(\theta+2k\pi)\}$$

and

$$\sqrt[3]{-\tfrac{1}{2}q-\sqrt{Q}}$$
$$=\sqrt[3]{r}\{\cos\tfrac{1}{3}(\theta+2k\pi)-i\sin\tfrac{1}{3}(\theta+2k\pi),$$

$k=0$, $\frac{1}{2}$, or 1. The y formulæ then give $y=2\sqrt[3]{r}\cos\frac{1}{3}(\theta+2k\pi)$.

The Biquadratic, or Quartic.—In general form this is $x^4+px^3+qx^2+rx+s=0$. The equivalent *reduced* quartic, $x^4+ax^2+bx+c=0$, is found by replacing x by $x-\frac{p}{4}$. To solve the reduced quartic, let $x=u+y+z$, then $x^4-2x^2(u^2+y^2+z^2)-8uyzx+(u^2+y^2+z^2)^2-4(u^2y^2+y^2z^2+z^2u^2)=0$; if this be identical with the reduced quartic, $a=-2(u^2+y^2+z^2)$, $b=-8uyz$, $c=(u^2+y^2+z^2)^2-4(u^2y^2+y^2z^2+z^2u^2)$. Owing to relations between the roots and coefficients of any equation (see THEORY OF EQUATIONS), the roots of the *auxiliary* cubic $t^3+\frac{a}{2}t^2+\frac{a^2-4c}{16}t-\frac{b^2}{64}=0$ are u^2, y^2, z^2. Denoting them by l, m, n, we have $x=\pm\sqrt{l}\pm\sqrt{m}\pm\sqrt{n}$, apparently eight values of x, but really only *four* because the product $uyz=-b:8$. If b is positive the values of x are $-\sqrt{l}-\sqrt{m}-\sqrt{n}$, $-\sqrt{l}+\sqrt{m}+\sqrt{n}$, $\sqrt{l}-\sqrt{m}+\sqrt{n}$, $\sqrt{l}+\sqrt{m}-\sqrt{n}$; if b is negative, they are the negatives of the former.

Historical and Critical Note.—As seen, the general equations of 4th and lower degrees are soluble by means of radicals or root extraction. It was naturally but incorrectly supposed that the same means would prove available in case of the general quintic and equations of higher degree, and one of the great problems of the eighteenth century was to solve the quintic in a manner analogous to that employed above for the quartic, cubic, and quadratic. In 1770 Lagrange proved that the method was not adequate for that purpose, as it gave for *auxiliary* equation an essentially general one of *sixth* degree. By Abel, Wantzel, and Galois (see GALOIS THEORY OF EQUATIONS) it was shown to be impossible to solve by radicals any *general* equation of degree above 4. Subsequently Hermite proved that the roots of the general quintic are expressible in terms of elliptic functions. The quadratic, cubic, and quartic are solvable by other methods than those given above, but all are essentially the same. The solution of the general quadratic was known to the Arabs in the ninth century. The solution of $x^3+px+q=0$ was discovered by Scipio Ferreo in the beginning of the sixteenth century. It was rediscovered a few years later by Tartaglia. The solution given above is known as Cardan's, but it is known that Cardan learned it from Tartaglia. Ferrari, a pupil of Cardan's, solved the quartic. The solution, given by Bombelli in his algebra (1579), is sometimes attributed to him. Descartes gave a different solution in 1637. The solution presented above is Euler's, having been found by him in 1770.

Higher Equations.—Although the *general* equations of the 5th and higher degrees are not solvable by radicals, many *particular* equations of such degrees are thus solvable; *e.g.*, $x^8-1=0$ breaks up into two quartics, $x^4-1=0$, $x^4+1=0$. In works on the theory of equations (see THEORY OF EQUATIONS) various methods, chief of which is Horner's, are given whereby the commensurable roots of any equation having numerical coefficients can be found and the incommensurable roots can be found to any required degree of approximation.

Simultaneous Equations.—The general linear equation in two variables or unknowns, as x and y, is $ax+by=c$. Solved for one of the variables, say x, in terms of the other, the equation becomes $x=\frac{c-by}{a}$. It is seen that x and y are functions of each other: to any value of either corresponds a value of the other. Any two

corresponding values constitute a *pair satisfying* the equation. There are infinitely many such pairs satisfying a given equation of the kind in question, as many pairs as there are numbers. Obviously there are hosts of pairs not satisfying a given equation. All the pairs satisfying a given equation constitute a *system* of pairs. Two equations $a_1x + b_1y = c_1$, $a_2x + b_2y = c_2$ are different unless $a_1 : a_2 = b_1 : b_2 = c_1 : c_2$. Have the two systems determined by two different equations any pairs in common? The answer is, *one* pair. It can be found as follows: Multiplying the former equation by b_2, the latter by $-b_1$, adding and solving for x, $x = (b_2c_1 - b_1c_2) : (a_1b_2 - a_2b_1)$; analogously, $y = (a_2c_1 - c_1a_2) : (a_1b_2 - a_2b_1)$. This and only this pair of values of x and y satisfies *both* equations. In combining the equations, x and y were regarded as the same in both. Two or more equations in two or more unknowns are called *simultaneous* when the unknowns are treated as representing the same numbers in all the equations. In the foregoing solution the x-equation was found by *eliminating y between* the given equations. The elimination was accomplished by *addition*. It might have been done otherwise, as by *comparison*, *i.e.*, solving each equation for y and equating the y-values so obtained, or by *substitution*, *i.e.*, solving one of the equations for y and substituting the y-value so found for y in the other equation. In any of these ways or by combinations of them one may find a triplet of values satisfying three arbitrary equations in three unknowns, x, y, z: eliminate, say z, between two of them and then between the remaining one and one of the others; so result two equations in x and y, to be handled as above. The method is obviously extensible to the case of n equations in n unknowns. In general, n linear equations in n unknowns are satisfied simultaneously by but a single set of values of the unknowns, but in special cases by more than one set. The latter happens only when the coefficients satisfy some special condition or conditions. Under certain conditions n or more equations in $n - 1$ unknowns may be satisfied by a same set of values. Thus $ax + b = 0$ and $cx + d = 0$ have the same root when and only when $bc - ad = 0$; $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$, $a_3x + b_3y + c_3 = 0$, are simultaneously satisfied or are *consistent* when and only when $a_1b_2c_3 + a_2b_3c_1 + a_3b_1c_2 - a_3b_2c_1 - a_2b_1c_3 - a_1b_3c_2 = 0$. For the expression of such conditions, and the solution of sets of linear equations, by means of determinants, see the article DETERMINANTS and works therein cited.

Simultaneous equations involving the unknowns to degrees higher than the first may sometimes be solved. Consider, for example, the pair of equations: $ax + by + c = 0$, $dx^2 + ey^2 + fxy + gx + hy + k = 0$; from the former $y = -(c + ax) : a$; substituting that y-value for y in the second given equation, a quadratic in x is found; this gives two x-values; substituting these in the given linear equation, the two *corresponding* values of y are found. The corresponding values must be properly *paired*; thus the equations $3x + 4y - 5 = 0$ and $2x^2 - xy + y^2 - 22 = 0$ give $x = 3$ and $-109 : 53$, $y = -1$ and $148 : 53$; the proper pairing is $x = 3$, $y = -1$, and $x = -109 : 53$, $y = 148 : 53$; the equations are not satisfied by $x = 3$, $y = 148 : 53$, for example. Once more, the two quadratics $x^2 + 3xy = 28$, $xy + 4y^2 = 8$ give, on division (member by member) and clearing of fractions, $2(x^2 + 3xy) = 7(xy + 4y^2)$; whence $x = 4y$ or $-7y : 2$. For $x = 4y$, the second given equation furnishes $4y^2 + 4y^2 = 8$ and $y = 1$ or -1, whence $x = 4$ or -4; using $x = -7y : 2$ in like manner, one finds $y = +4$ or -4 and $x = -14$ or 14; in all four pairs of values corresponding thus: $x = 4$, $y = 1$; $x = -4$, $y = -1$; $x = 14$, $y = -4$; $x = -14$, $y = 4$. In general, an equation of mth degree and one of nth degree in two unknowns are both satisfied by mn pairs of numbers. The solution of such a pair involves, in general, the solution of an equation of degree mn.

Permutations and Combinations.—Any arrangement (in a row) of r things (regarded as belonging to a set of n things) is called a (straight) *permutation of the n things r at a time.* Two permutations are the same when and only when they consist of the same things in the same order. The number of different (possible) permutations of n things r at a time is often denoted by ${}_nP_r$. To find this number, think of *any* one of the ${}_nP_{r-1}$ permutations of n things $r - 1$ at a time. There remain $n - r + 1$ things. Put one of these after the things of the given permutation. There so results a permutation of the n things r at a time. It readily follows that ${}_nP_r = {}_nP_{r-1} \cdot (n - r + 1)$, ${}_nP_{r-1} = {}_nP_{r-2} \cdot (n - r + 2)$, $\ldots$, ${}_nP_2 = {}_nP_1 \cdot (n - 1)$, ${}_nP_1 = n$. Multiplying these equations member by member, it is found that ${}_nP_r = n(n - 1) \ldots (n - r + 1)$. If $r = n$, ${}_nP_n = n!$, where $n!$ (or $\underline{|n}$) means $1 \times 2 \times 3 \times \ldots \times n$ and is read *factorial n*. It can be readily proved that the number P of permutations of n things $(a, b, c, \ldots)$ n at a time, p of the things being a's, q of them b's, $\ldots$, is $P = \frac{n!}{p!\,q!\ldots}$. If the *order* in a permutation of n things r at a time be disregarded, the result is a *combination* of n things r at a time. Two combinations are the same if they consist of the same elements. A common symbol for the number of combinations of n things r at a time is ${}_nC_r$. By permuting the r things of a combination in every way, $r!$ permutations arise. It follows that ${}_nC_r \cdot r! = {}_nP_r$, whence ${}_nC_r = {}_nP_r : r!$. Since, on taking r things from n things, there remain $n - r$ things, it is seen that ${}_nC_r = {}_nC_{n-r}$.

Arithmetical Progression.—An *A.P.* is a series of numbers such that the difference between any two adjacent terms is the same as that between any other two adjacent terms. The general *A.P.* is: $a, a + d, a + 2d, \ldots, a + \overline{n-1}d$. The theory involves five elements: the common difference, d; the first term, a; the last, l; the number of terms, n; and the sum of the terms, s. Given any three of the elements, the remaining two can be found. Since ${}_5C_3 = 10$, there are but 20 problems to solve, giving rise to as many formulæ. The formula for l in terms of a, d, and n obviously is $l = a + \overline{n-1}d$. To find s in terms of a, l, and n, let $s = a + (a + d) + (a + 2d) + \ldots + (l - 2d) + (l - d) + l$; then $s = l + (l - d) + (l - 2d) + \ldots + (a - 2d) + (a - d) + a$; adding, $2s = n(a + l)$, whence $s = \frac{n}{2}(a + l)$. The remaining eighteen formulæ, completely exhausting the subject, are: $l = -\frac{1}{2}d + \sqrt{2ds + (a - \frac{1}{2}d)^2}$; $l = \frac{2s}{n} - a$; $l = \frac{s}{n} + \frac{(n-1)d}{2}$; $s = \frac{1}{2}n(2a + \overline{n-1}d)$; $s = \frac{l + a}{2} + \frac{l^2 - a^2}{2d}$; $s = \frac{1}{2}n(2l - \overline{n-1}d)$; $a = l - \overline{n-1}d$;

$a = \frac{s}{n} - \frac{1}{2}(n-1)d$; $a = \frac{1}{2}d \pm \sqrt{(l+\frac{1}{2}d)^2 - 2ds}$; $a = \frac{2s}{n} - l$; $d = (l-a) \div (n-1)$; $d = 2(s-an) \div n(n-1)$; $d = (l^2-a^2) \div (2s-l-a)$; $d = 2(nl-s) \div n(n-1)$; $n = 1 + (l-a) \div d$; $n = (d-2a \pm \sqrt{(2a-d)^2+8ds}) \div 2d$; $n = 2s \div (a+l)$; $n = (2l+d \pm \sqrt{(2l+d)^2-8ds}) \div 2d$.

Geometric Progression.—A *G.P.* is a series of numbers such that the ratio of any one to the next is equal to the ratio of any other one to its next. Accordingly, the general form of a *G.P.* is: $a, ar, ar^2, \ldots, ar^{n-1}$. Again, there are five elements to be considered: the first term, a; the last, l; the ratio, r; the number of terms, n; and the sum of the terms, s. In terms of any three of the five elements, either of the remaining elements can be expressed. Accordingly the theory of the *G.P.* involves the solution of but twenty problems. Most important of these are the problems, to express l in terms of a, r, and n, and to express s in terms of a, r, and n. It is plain that l, or the nth term, is $l = ar^{n-1}$. To find s, let $s = a + ar + \ldots + ar^{n-2} + ar^{n-1}$; then $rs = ar + ar^2 + \ldots + ar^{n-1} + ar^n$; subtracting, and dividing by $1-r$, it is found that $s = \frac{a(1-r^n)}{1-r} = \frac{a-rl}{1-r}$. The remaining eighteen formulæ are easily obtained. If r be numerically less than 1, the *G.P.* is said to be a *decreasing G.P.*; otherwise, not. In case of a decreasing *G.P.*, it is possible to *sum the series to infinity*, a phrase requiring explanation. An endless series, $a_1, a_2, \ldots$, is said to be *infinite*, *i.e.*, to contain an infinite number of terms. A series that has an end, a last term, is finite. Let s_n denote the sum of the *first n* terms of an infinite series. If the series be such that there is a finite number L from which, by taking n large enough, s_n may be made to differ by less than any prescribed amount and to which s_n, as n continues to increase, approaches nearer and nearer in value, then L is named *limit of s_n as n increases endlessly*, the series is said to be *convergent* (see SERIES) and L is called the *sum* (to infinity) of the series. Observe that here the word *sum* is used in a new sense, viz., as limit of a sum (in old sense). Now consider the *infinite G.P.*, $a, ar, ar^2, \ldots, ar^{n-1}, ar^n, \ldots$. The sum s_n of the first n terms, by the foregoing formula for s, is: $s_n = \frac{a}{1-r} - \frac{ar^n}{1-r}$. If the *G.P.* is a decreasing one, $r < 1$ numerically, r^n approaches *zero* as *limit* as n increases without bound, and hence s_n has $\frac{a}{1-r}$ for limit, the *G.P.* is a convergent series, and its sum to infinity is $s = \frac{a}{1-r}$. For example, the sum of the infinite series, $1, \frac{1}{2}, \frac{1}{4}, \ldots$, is $s = \frac{1}{1-\frac{1}{2}} = 2$.

Harmonical Progression.—An *H.P.* is a series of numbers such that the series of their reciprocals is an *A.P.* Hence the typical *H.P.* is of the form $\frac{1}{a}, \frac{1}{a+d}, \frac{1}{a+2d}, \ldots, \frac{1}{a+(n-1)d}$. It is obvious that every problem involving an *H.P.* is convertible into a problem involving an *A.P.* If a and b be any two numbers, their *arithmetic mean* is a number c such that the series a, c, b is an *A.P.* Hence $c - a = b - c$, whence $c = \frac{1}{2}(a+b)$; *i.e.*, the arithmetic mean of two numbers is half their sum. The *geometric mean* of a and b is a number c such that the series a, c, b is a *G.P.* Hence $\frac{c}{a} = \frac{b}{c}$, whence $c = \sqrt{ab}$; *i.e.*, the geometric mean of two numbers is the square root of their product. The harmonic mean of a and b is c, where c is such that the series a, c, b is an *H.P.* Hence $\frac{1}{a}, \frac{1}{c}, \frac{1}{b}$ is an *A.P.* Hence $\frac{1}{c} - \frac{1}{a} = \frac{1}{b} - \frac{1}{c}$, whence $c = \frac{2ab}{a+b}$. Denote by A, G, and H respectively the arithmetic, the geometric, and the harmonic means of a and b. Then $A = \frac{1}{2}(a+b)$, $G = \sqrt{ab}$, $H = \frac{2ab}{a+b}$. It is readily seen that $H = G^2 : A$, whence $G = \sqrt{AH}$; *i.e.*, the geometric mean of two numbers is the geometric mean of their arithmetic and their harmonic means.

The Binomial Theorem or Expansion.—If a and b are any numbers and n is any positive integer,

$$(a+b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{1 \cdot 2}a^{n-2}b^2 + \ldots$$
$$+ \frac{n(n-1)(n-2)\ldots(n-r+1)}{1 \cdot 2 \cdot 3 \cdot \ldots \cdot r}a^r b^{n-r} + \ldots$$
$$+ nab^{n-1} + b^n,$$

an expansion containing $n+1$ terms. For proof of the relationship see article MATHEMATICAL INDUCTION. It can be proved by algebraic means, most readily by Maclaurin's formula (see CALCULUS), that, if a is numerically greater than b and n is any real number, the same expansion as that above given is valid, *i.e.*, $(a+b)^n = a^n + na^{n-1}b + \ldots$, which, however, contains an infinite number of terms, except in the case where n is a positive integer. The equation is called the *binomial theorem*. It was discovered by Sir Isaac Newton, but its correctness was not proved by him. One of the simplest of its countless applications is its application to the problem of finding correct to any required degree of approximation any real root of any real number. For example, suppose it is desired to know the real cube root of 25 correct to five decimal places. We may proceed as follows:

$$\sqrt[3]{25} = (25)^{\frac{1}{3}} = (27-2)^{\frac{1}{3}} = (3^3-2)^{\frac{1}{3}} = (3^3)^{\frac{1}{3}}$$
$$- \tfrac{1}{3}(3^3)^{-\frac{2}{3}}(2) - \tfrac{1}{9}(3^3)^{-\frac{5}{3}}2^2 - \tfrac{5}{81}(3^3)^{-\frac{8}{3}}2^3 - \ldots$$
$$= 3 - \frac{2}{3 \cdot 3^2} - \frac{4}{9 \cdot 3^5} - \frac{40}{81 \cdot 3^8} - \ldots = 2.92402.$$

The Number e and the Series for e^x.—If n be numerically greater than 1, the foregoing theorem yields the equations

$$\left(1 + \frac{1}{n}\right)^n = 1 + 1 + \frac{1 - \frac{1}{n}}{2!} + \frac{\left(1 - \frac{1}{n}\right)\left(1 - \frac{2}{n}\right)}{3!} + \ldots;$$

$$\left(1 + \frac{1}{n}\right)^{nx} = 1 + x + \frac{x\left(x - \frac{1}{n}\right)}{2!} + \frac{x\left(x - \frac{1}{n}\right)\left(x - \frac{2}{n}\right)}{3!} + \ldots.$$

Hence

$$\left\{1 + 1 + \frac{1 - \frac{1}{n}}{2!} + \frac{\left(1 - \frac{1}{n}\right)\left(1 - \frac{2}{n}\right)}{3!} + \ldots\right\}^x$$
$$= 1 + x + \frac{x\left(x - \frac{1}{n}\right)}{2!} + \frac{\left(x - \frac{1}{n}\right)\left(x - \frac{2}{n}\right)}{3!} + \ldots.$$

This equation is valid for every value of n numerically greater than 1. The limits approached by its members as n increases beyond every finite value are equal; *i.e.*,

$$\left(1+1+\frac{1}{2!}+\frac{1}{3!}+\ldots\right)^x=1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\ldots.$$

The series on the right is convergent for every finite value of x; in fact, for any given value of x, the series after a certain number of terms converges more rapidly than any decreasing *G.P.* The series on the left is a special case of that on the right, viz., $x=1$. The *limit* of the sum of the first n terms of the series on the left, *i.e.*, its sum (to infinity) is denoted by e; accordingly the equation may be written: $e^x=1+x+\frac{x^2}{2!}+\frac{x^3}{3!}+\ldots$ The meaning is that the number e raised to a power indicated by a given value of x is the sum to infinity of the series for that value of x. Since $e=1+1+\frac{1}{2!}+\frac{1}{3!}+\ldots$, its approximate value can be readily calculated. That value, correct to ten decimal places, is $e=2.7182818284$. The number e, one of the most important of all numbers, is incommensurable, *i.e.*, not exactly expressible as a rational fraction, and it is *transcendental*, *i.e.*, not a root of an equation $ax^n+bx^{n-1}+\ldots=0$, where the coefficients $a, b, \ldots$ are integers (see GENERAL THEORY OF ASSEMBLAGES).

Logarithms.—Let a be any positive number greater than 1. If $a^x=N$, x is named *logarithm of N to the base a*; symbolically, $x=\log_a N$, or, if the base is supposed known, simply $x=\log N$. If a be fixed, x and N will vary each with the other, each is a function of the other. Since $a^0=1$, $\log 1=0$ no matter what the base. But in general the logarithm of a given number will vary with the base; thus, since $2^4=16$, $4^2=16$, $\log_2 16=4$, $\log_4 16=2$. The general connection can be readily found thus: let $a^x=N$ and $b^y=N$, then $\log_a N=x$ and $\log_b N=y$; also $a^x=b^y$, $a=b^{\frac{y}{x}}$, $\log_b a=\frac{y}{x}=\frac{\log_b N}{\log_a N}$; whence $\log_b N=\log_a N\cdot\log_a b$. Calling a an old and b a new base, it is seen that the logarithm of a given number to a new base is equal to the product of the logarithm of the number to the old base and the logarithm of the new base to the old base. Let $a^x=N$, $a^y=M$, then $a^{x+y}=NM$; hence the logarithm of a product is the sum of the logarithms of the factors. Again, $(a^x)^\kappa=N^\kappa=a^{\kappa x}$; whence it is seen that the logarithm of the κth power of a number is κ times the logarithm of the number. Once more, $\frac{a^x}{a^y}=a^{x-y}$; that is, the logarithm of a fraction is equal to that of the numerator minus that of the denominator. Logarithms to the base 10 are called *common* logarithms or *Briggsian* logarithms, after Briggs, who introduced them in 1615. These are used in practical computation, but in theoretical work logarithms are referred to the number e, the *Napierian* base, so called after *Napier* (1550–1617), the inventor of logarithms.

Let N be any number and n any positive integer. Then $\log_{10}(N\cdot 10^n)=\log_{10}N+n\log_{10}10=n+\log_{10}N$; and $\log_{10}(N\div 10^n)=\log_{10}N-n\log_{10}10=-n+\log_{10}N$. Now multiplication or division by a power of 10 has only the effect of moving the decimal point, while the logarithm of the product, as just seen, is equal to that of the multiplicand (or dividend) increased (or decreased) by an integer. Accordingly, if two numbers differ only in the position of the decimal point, their logarithms differ only in respect to the integral part (called the *characteristic*), the fractional part (called the *mantissa*) being the same in both. In that fact resides the chief practical advantage of the Briggsian system. For example, if $\log_{10}2.23=.3483$, it follows that $\log_{10}22.3=1.3483$; and $\log_{10}.00223=\log_{10}(2.23\div 10^3)=-3+.3483$, or $\bar{3}.3483$, as *negative* characteristics are often written. It is easy to see that the characteristic of a logarithm is $+n$ if the number has $n+1$ figures before the decimal point, and is $-n$ if the number is a pure decimal in which the point is followed by $n-1$ zeros. Thus, $\log_{10}23506.054=4+$a pure decimal, and $\log_{10}.0008953=\bar{4}+$a pure decimal.

Exponential and Logarithmic Series, Calculation of Logarithms.—On replacing x in the series for e^x by $x\log_e a$, there results the *exponential* series, $a^x=1+(\log_e a)x+(\log_e a)^2\frac{x^2}{2!}+\ldots$ In this replace x by y and a by $1+x$. The result is, $(1+x)^y=1+y\log_e(1+x)+\ldots$ Also, if x be numerically less than 1, the binomial theorem gives $(1+x)^y=1+yx+\ldots$ These series being equal for all values of y, the coefficients of like powers of y are equal (see *Undetermined Coefficients*, below). Hence, for $x<1$ numerically, $\log_e(1+x)=x-\frac{x^2}{2}+\frac{x^3}{3}-\frac{x^4}{4}+\frac{x^5}{5}-\ldots$, the *logarithmic* series. Replacing x by $-x$, $\log_e(1-x)=-x-\frac{x^2}{2}-\frac{x^3}{3}-\frac{x^4}{4}-\frac{x^5}{5}-\ldots$ The logarithmic series converges *slowly* for all but small values of x. It is on that account ill adapted to the computation of Napierian logarithms. A series better adapted to such calculation is, however, readily obtained as follows: From the last two series it follows that $\log_e\frac{1+x}{1-x}=2\left(x+\frac{x^3}{3}+\frac{x^5}{5}+\ldots\right)$. Put $x=\frac{m-n}{m+n}$, so that $\frac{1+x}{1-x}=\frac{m}{n}$, then

$$\log_e\frac{m}{n}=2\left\{\frac{m-n}{m+n}+\frac{1}{3}\left(\frac{m-n}{m+n}\right)^3+\frac{1}{5}\left(\frac{m-n}{m+n}\right)^5+\ldots\right\},$$

a rapidly converging series that may be used for the calculation of logarithms as follows. For $m=2$ and $n=1$, we get $\log_e 2=0+2\{\frac{1}{3}+\frac{1}{3}(\frac{1}{3})^3+\ldots\}$, whence $\log_e 2=.693147$ (correct to six decimal places). For $m=3$ and $n=2$, the series gives $\log_e 3=\log_e 2+2\{\frac{1}{5}+\frac{1}{3}(\frac{1}{5})^3+\ldots\}=1.098612$. Taking $m=5$ and $n=3$, it is found that $\log_e 5=1.609438$ Then $\log_e 4=2\log_e 2$, $\log_e 6=\log_e 2+\log_e 3$, $\log_e 8=3\log_e 2$, and so on. In particular $\log_e 10=\log_e 2+\log_e 5=2.302585$. Since $\log_e N=(\log_e N)(\log_e 10)$, it is seen that the common logarithm of any number may be found from the Napierian logarithm of that number by multiplying the latter logarithm by 2.302585 This last is called the *modulus of common logarithms*. It is obviously possible to calculate logarithms that shall be correct to any prescribed number of decimal places. Logarithms correct to 3 or 4 places are sufficiently accurate for all ordinary computations, though tables correct to 5, 6, 7 and even 10 or more places are often employed By means of any such table can be found the logarithm of any given number, and conversely The number corresponding to a given logarithm is often called the *antilogarithm*. The advantage of loga-

rithmic over ordinary computation is easily seen. Thus to find the product of two or more numbers, it suffices to add their logarithms and then to take the antilogarithm of the sum. To extract any root, say the 7th, of any number, it suffices to divide the logarithm of the number by 7 and to take the antilogarithm of the quotient. To find the quotient of two numbers, it suffices to subtract the logarithm of the divisor from that of the dividend and to take the antilogarithm of the difference. The *cologarithm* of a number is the logarithm of the reciprocal; thus, $\operatorname{colog} n = \log \frac{1}{n} = \log 1 - \log n = 0 - \log n$; hence to subtract a logarithm is equivalent to adding the corresponding cologarithm.

Undetermined Coefficients. — Reference was made above to this subject, of which some account will now be given. Let $f(x) \equiv a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x + a_n$, a rational integral function of degree n in x. It can be proved and is here assumed that any such function vanishes for some value of the variable. If $f(r_1) = 0$, then, by the factor theorem, $f(x) \equiv (x - r_1)f'(x)$, where $f'(x) \equiv a_0x^{n-1} + \ldots$ If $f'(r_2) = 0$, then $f'(x) \equiv (x - r_2)f''(x)$, where $f''(x) \equiv a_0x^{n-2} + \ldots$, and hence $f(x) \equiv (x - r_1)(x - r_2)f''(x)$. By the argument here exemplified it is proved that $f(x)$ may be put in the form $f(x) \equiv a_0(x - r_1)(x - r_2) \ldots (x - r_n)$. Each of the n numbers $r_1, r_2, \ldots, r^n$ causes $f(x)$ to vanish; hence the n numbers are roots of the equation $f(x) = 0$. It can be easily seen that the equation $f(x) = 0$ cannot have more than n different roots unless its coefficients are each zero; that is, $f(x)$ cannot vanish for more than n different values of x unless $a_0 = a_1 = \ldots = a_n = 0$. For if $f(r_{n+1}) = 0$, then $a_0(r_{n+1} - r_1)(r_{n+1} - r_2) \ldots (r_{n+1} - r_n) = 0$, but by hypothesis no ( ) $= 0$, hence $a_0 = 0$, and $f(x) = a_1x^{n-1} + \ldots$ As the latter is to vanish for more than $n - 1$ values of x, $a_1 = 0$. In like manner it would follow that $a_2 = 0, \ldots, a_n = 0$. But if the coefficients are each zero, $f(x)$ vanishes for every value of x. If $f(x)$ vanishes for more than n values of x, it vanishes for all values of x. Now suppose that $a_0x^n + a_1x^{n-1} + \ldots + a_n$ is to be equal to $b_0x^n + b_1x^{n-1} + \ldots + b_n$ for all values of x, then the function $(a_0 - b_0)x^n + (a_1 - b_1)x^{n-1} + \ldots + (a_n - b_n)$ must vanish for every value of x, and, consequently, $a_0 = b_0$, $a_1 = b_1, \ldots, a_n = b_n$. Hence two rational integral functions of degree n in x are equal for all values of x, *i.e.*, are *identical*, when and only when the coefficients of like powers of x are equal. This proposition enables us to solve many problems involving the determination of *undetermined coefficients.* For example, suppose it required to find the sum of the squares of the first n integers. Assume the identity $1^2 + 2^2 + \ldots + (n-1)^2 + n^2 \equiv a + bn + cn^2 + dn^3 + en^4 + fn^5 + \ldots$, where the coefficients $a, b, \ldots$ are to be determined. Replacing n by $n+1$, we obtain $1^2 + 2^2 + \ldots + n^2 + (n+1)^2 \equiv a + b(n+1) + c(n+1)^2 + d(n+1)^3 + e(n+1)^4 + \ldots$ By subtracting corresponding members of the identities, there results the identity $n^2 + 2n + 1 \equiv b + 2cn + c + 3dn^2 + 3dn + d + 4en^3 + 6en^2 + 4en + e + \ldots$ As this relation is to be valid for every value of n, coefficients of like powers of n must be equal. Hence $e = 0$, $f = 0, \ldots, 1 = 3d$, $2 = 3d + 2c$, $1 = b + c + d$; hence $b = \frac{1}{6}$, $c = \frac{1}{2}$, $d = \frac{1}{3}$. Accordingly, $1^2 + 2^2 + \ldots + (n-1)^2 + n^2 = a + \frac{1}{6}n + \frac{1}{2}n^2 + \frac{1}{3}n^3$, true for every value of n, hence for $n = 1$, and hence $a = 0$. Therefore $1^2 + 2^2 + \ldots + n^2 = \frac{1}{6}n(n+1)(2n+1)$.

Part-fractions.—The so-called principle of undetermined coefficients has frequent application in the solution of the problem, to decompose a given fraction into part-fractions (commonly called partial fractions) whose sum shall be the given fraction. Any fraction whose terms are rational integral functions of x may be thus decomposed. The method of procedure may be made sufficiently clear by a few examples. It will be observed that the problem is in a sense the inverse of the problem of summing fractions. For example, the sum of $\frac{2}{x}$, $\frac{5}{3(1-x)}$, and $\frac{-1}{3(2+x)}$ is $\frac{x+4}{2x - x^2 - x^3}$ or $\frac{x+4}{x(1-x)(2+x)}$. The inverse problem is: given the latter fraction, to find its components. It is plain that the only fractions whose denominators are linear and whose sum is a fraction of the proper denominator and a linear numerator are $\frac{a}{x}$, $\frac{b}{1-x}$, and $\frac{c}{2+x}$. Hence we assume: $\frac{x+4}{2x - x^2 - x^3} = \frac{a}{x} + \frac{b}{1-x} + \frac{c}{2+x}$, whence

$$x + 4 = a(1-x)(2+x) + bx(2+x) + cx(1-x),$$

which is to be valid for all values of x. Expanding the right-hand member and equating corresponding coefficients on right and left, we obtain: $4 = 2a$, $1 = -a + 2b + c$, $0 = -a + b - c$; whence $a = 2$, $b = \frac{5}{3}$, $c = -\frac{1}{3}$; and the component fractions are seen to be $\frac{2}{x}$, $\frac{5}{3(1-x)}$, $\frac{-1}{3(2+x)}$. For another example, we may take $F \equiv \frac{4x^2 + 3x - 1}{(x-1)^2(x+2)}$. A little reflection suffices to show that the assumption to be made is $F = \frac{a}{x-1} + \frac{b}{(x-1)^2} + \frac{c}{(x+2)}$. Then $4x^2 + 3x - 1 = a(x-1)^2 + b(x-1)(x+2) + c(x+2)$; equating coefficients and solving the resulting equations, it is found that $a = 1$, $b = 3$, $c = 2$. In case a factor of the given denominator is repeated κ times, as in $\frac{N}{(mx+n)^\kappa(px+q)}$, the assumption to be made is: given fraction $= \frac{a_1}{mx+n} + \frac{a_2}{(mx+n)^2} + \ldots + \frac{a_\kappa}{(mx+n)^\kappa} + \frac{b}{(px+q)}$. If F is of the form $\frac{N}{(mx^2+nx+l)^\kappa(px+q)^s(gx+h)}$, then assume $F = \frac{ax+b}{mx^2+nx+l} + \frac{ax+b}{(mx^2+nx+l)^2} + \ldots + \frac{ax+b}{(mx^2+nx+l)^\kappa}$ + etc., as before. If N is of degree equal to or higher than that of the given denominator, F is converted by division into an integral function + a fraction the degree of whose denominator exceeds that of its numerator. The latter fraction is then decomposed by the methods above indicated.

Indeterminate (*Undetermined, Evanescent, Illusory*) *Forms.*—In case of a fraction, $\phi(x) \equiv \frac{f(x)}{F(x)}$, it may happen that both terms vanish for some value of x, as $x = a$, yielding the form $\frac{0}{0}$, which, as division by zero is meaningless, is itself without meaning and is commonly called indeterminate. In such case we are free (logically) to *give* the form a meaning, any meaning or value whatever. But while all meanings (values) are allowable, not all are expedient. For ex-

ample, $\dfrac{x^2-a}{x-a}$ has a definite value for every x-value except $x=a$. For this value the fraction takes the form $\dfrac{0}{0}$. To this we might assign the value of 5 or -3, or any other. But such a choice would be motiveless. On the other hand, $\dfrac{x^2-a^2}{x-a}=x+a$ for all values of x except a; for this *critical* value a, the right member takes a definite value, $2a$, which is accordingly suggested as the value to be naturally assigned to the indeterminate form in this case. The decisive motive for this choice lies yet deeper: it is that as x varies through a sequence of values, say $a+\frac{1}{2}$, $a+\frac{1}{4}$, $a+\frac{1}{8}, \ldots$, having a as limit, the corresponding sequence of fraction-values, $2a+\frac{1}{2}$, $2a+\frac{1}{4}$, $2a+\frac{1}{8}$, $\ldots$, approaches $2a$ as limit. Accordingly, if $\phi(x)$ assumes the form $\dfrac{0}{0}$ for $x=a$, the value assigned to $\phi(a)$ is the limit value which the sequence of fraction-values approaches as x approaches a through any sequence of x-values for each of which $\phi(x)$ has a definite value. The fraction $\phi(x)$ may be such that as x approaches a, $f(x)$ approaches a definite value other than zero and that $F(x)$ approaches zero. Such a fraction is $\dfrac{x-a+4}{x-a}$. In such case the fraction-value obviously becomes larger and larger, surpassing every prescribed number, a fact commonly expressed by saying that as x approaches a, $\phi(x)$ approaches positive or negative infinity (∞ or $-\infty$) according as the numbers in the fraction sequence are positive or negative. If, as x approaches a, both $f(x)$ and $F(x)$ approach ∞, then, for $x=a$, $\phi(x)$ assumes the indeterminate form $\dfrac{\infty}{\infty}$. But it may be made to take the form $\dfrac{0}{0}$, since $f(x) \div F(x)=(1 \div F(x)) \div (1 \div f(x))$ Other indeterminate forms also reducible to the form $\dfrac{0}{0}$, are $0.\infty$, $\infty.0$, $\infty-\infty$, ∞°, 0^{∞}. For further treatment see CALCULUS.

The boundary of what is or should be called elementary algebra is ill defined alike in theory and in practice, and beside the topics dealt with in this article other subjects are briefly treated in some of the elementary text-books. Of such additional subjects, the more important, as *chance* or *probability*, the *complex variable*, and *theory of numbers*, *series*, and others, are subjects of special articles in this work. Relatively meager, merely introductory, text-books of algebra are sometimes quite absurdly described in their titles as «complete,» and others that might be called advanced are improperly characterized as «higher.» The better usage has appropriated the term higher algebra to the doctrine of invariants and covariants (q.v.).

Bibliography.—Text-books of elementary algebra, good, bad, and indifferent, are very numerous. The most scientific work on the subject is that by Weber and Wellstein: 'Elementare Algebra und Analysis.' The most comprehensive elementary English text-book is Chrystal's 'Algebra,' 2 vols.

CASSIUS J. KEYSER,
Professor of Mathematics, Columbia University.

Algebra, History of the Elements of. Taking the definition of algebra as given in the article under that title (q.v.), the history of the subject goes back to the early Egyptians. In a certain hieratic papyrus now in the British Museum, copied by one Ahmes (*Aāhmesu*, the moon-born), about 1700 B.C., from a work written some centuries earlier, several traces of algebra appear. There are symbols for addition, subtraction, and equality, and eleven examples of linear equations with one unknown quantity are given. The unknown quantity is called *hau*, or heap, the first example involving an equation being "Heap, its seventh, its whole, it makes nineteen" that is, $\frac{x}{7}+x=19$. A number of applied problems are also given, and Ahmes shows some familiarity with arithmetic and geometric progressions. Such was the stagnation of the later Egyptians, however, that algebra never advanced beyond this point, on the banks of the Nile, at least until Greek influence established the famous school of Alexandria.

The Greek mind turned to the science of form rather than to that of number (see GEOMETRY, HISTORY OF THE ELEMENTS OF), and consequently but few evidences of algebra are found in Greece during the golden age of philosophy. Whenever a need for algebra is met it is always for the solution of some geometric problem, and whenever a solution is effected it is usually by some device involving geometry. One of the earliest evidences of an algebraic symbolism is seen in a problem of Aristotle's, in which he represents quantities by means of letters, letting **A** stand for the moving force, **B** for that by which it is moved, **Γ** for the distance, **Δ** for the time, and so on. About the same time Hippocrates (q.v.) called the square of a number **δύναμις** (power), from which the Latins derived the name *potentia*, which appears in our language as *power*. Euclid (q.v.), c. 300 B.C., proved geometrically certain fundamental laws of algebra, such as $a(b+c)=ab+ac$, $(a+b)^2=a^2+2ab+b^2$, $(a-b)^2=a^2-2ab+b^2$, and $(a+b)(a-b)=a^2-b^2$. The equation of the second degree was also known to the Greeks, and they were able to solve the general case by the aid of proportion. Archimedes (q.v.) is even said to have solved one case of the cubic, and he undoubtedly knew a considerable amount about series.

It was not, however, until the time of Diophantus (q.v.), c. 300 A.D., that Greek algebra attained any standing as a separate science. This great mathematical genius improved the symbolism, divorced the subject from geometry, and created the ancient science of indeterminate equations, a science called in his honor «Diophantine Analysis.»

For reasons above suggested, algebra flourished more naturally in the Orient than in Greece. The first Hindu algebraist of any importance was Aryabhata, who was born at Pataliputra, on the Upper Ganges, in 476 A.D. Part of his «Aryabhattiyam» is devoted to algebra, and covers the fundamental operations, rules for

square and cube roots, progressions, permutations, equations of the first and second degrees with one unknown quantity, and some treatment of indeterminate equations. Aryabhata differs from Diophantus in that he considers algebra from a broader standpoint, treating it rather as a theory of elementary functions than as the science of a particular form of the equation.

The next great algebraist in the East was Al Khowarazmi (q.v.), c. 800 A.D., so called from his birthplace, Kharazm, the territory of the modern Khiva. With him algebra takes a still different meaning. It is no longer the theory of indeterminate equations of Diophantus, nor is it chiefly the theory of elementary functions of Aryabhata, but it becomes primarily the general theory of equations. Indeed the title of his work 'ilm al-jabr wa' l muqābalah,' means the science of redintegration and equation, a title from which only the words *al-jabr* have survived, giving the accidental name of *algebra* to the subject. Al Khowarazmi solved three types of the quadratic, in modern symbolism $x^2 + ax = b$, $x^2 - ax = b$, $x^2 + b = ax$, thus showing his inability to generalize, a failing with all writers before the 17th century.

It was two centuries before another writer of prominence appeared. About 1010 A.D., Al Karchi, like Al Khowarazmi of the Bagdad school, wrote a treatise in which he shows familiarity with the works of his predecessors rather than great genius himself. Like many of the older writers, he gives attention to those rules for approximating roots, so necessary before the time of decimal fractions. Stated in modern symbolism his rule for square root is $\sqrt{a} = w + \frac{a - w^2}{2w + 1}$; that is, $\sqrt{10} = 3 + \frac{10 - 9}{6 + 1} = 3\frac{1}{7}$, whence $\sqrt{10}$ was often used for π. He also gives the rule $\sqrt{a + b \pm \sqrt{4ab}} = \sqrt{a} \pm \sqrt{b}$, and a rule for Σn^3.

In the 12th century two Oriental writers of prominence appear, Omar Khayyam (q.v.) the Persian, who died in 1123, and Bhaskara the Hindu, who was born in 1114. Omar solved one case of the cubic, and was the first to treat equations above the second degree in a systematic manner. The binomial theorem with positive integral exponents was also known to him. His algebra, published in Paris both in Arabic and in French, made Omar known in the West as an algebraist some time before FitzGerald made him celebrated as a poet.

Bhaskara wrote on both arithmetic and algebra, and his work has long been known in Europe through Colebrook's English translation. Among the features of his algebra is the statement that $\frac{a}{o} = \infty$, and the solution of the quadratic by the reduction of $ax^2 + bx + c = o$ to the form $(2ax + b)^2 = -4ac + b^2$, a device known in England as the Hindu Method.

The rise of modern elementary algebra took place in Italy in the 16th century. It was at this time that the cubic was solved by Tartaglia (q.v.), the publication being made by Cardan (q.v.) in his *Ars Magna* in 1545. The solution of the quartic soon followed, after which the quintic occupied the attention of algebraists until its solution was proved to be impossible by the operations of elementary algebra, in the 19th century. A common name for algebra at this time was "L'arte maggiore" (the greater art, whence the Latin title of Cardan's treatise), arithmetic being called by contrast "L'arte menore" (the lesser art). The unknown quantity was called, in Latin, *res*, whence the Italian translation *cosa* (thing). On this account the science was called the *Coss* in the early German schools, and the name "Cossic Art" was not uncommon among the English writers of about 1600. The mere processes and solutions of elementary algebra were fairly perfected by the close of the 16th century, and little besides the symbolism was needed to make the subject what it is to-day.

The title of Father of modern elementary algebra is frequently given to Vieta (q.v.). He was the first to devise a systematic and fairly satisfactory scheme of literal notation, using vowels for the unknown quantities and consonants for the knowns. For example, he used *A* where we use x, *Aq* (*A quadratus*) for our x^2, *Ac* for x^3, *Aqq* for x^4, and so on. He also recognized that a letter may represent both a positive and a negative number, and both an integer and a fraction, a generalization not recognized by his predecessors, and one that was perfected later by Descartes. Vieta was also the first to recognize the advantage of making the second member zero in considering an equation. His work greatly influenced the English algebra as set forth by Harriot (q.v.), who acknowledged his indebtedness to him. Mention should also be made of the work of Clavius, who did much to meet the demand for a usable text-book at this period.

The final touch was put upon the elementary science by Descartes (q.v.), who suggested and used our modern literal notation, and who perfected the generalizations begun by Vieta. His introduction of the graphic treatment of equations not only revolutionized mathematics in general, but materially assisted in the understanding of the elements.

Since Descartes's time there have been certain improvements in the symbolism of elementary algebra, the theory of approximate solutions of numerical higher equations has been created, chiefly through the efforts of Newton, Euler, and Horner (qq.v.), the binomial theorem has been generalized for negative and fractional exponents, principally by the labors of Newton, the theory and the symbolism of determinants (q.v.) have been developed, the various number systems met in algebra (notably the complex number) have been placed upon a scientific basis, and in general the foundation theories of the science have been greatly strengthened.

Bibliography.—Eisenlohr, 'Ein mathematisches Handbuch der alten Egypter' (Leipsic 1877); Heath, 'Diophantos' (Cambridge 1885); Matthiessen, 'Grundzüge der antiken und modernen Algebra der litteralen Gleichungen' (Leipsic 1878); Cantor, 'Geschichte der Mathematiks' (Leipsic 1880–98, various editions).

DAVID EUGENE SMITH,
Professor of Mathematics, Teachers College, Columbia University, New York.

Algeciras, or **Algesiras,** a seaport of Spain, on the west side of the Bay of Gibraltar, and 7 m. N.W. of Europa Point. The old town, once possessed of great strength, but now in

ruins, stood on the Isla Verde; the modern town stands on the mainland, on an acclivity rising rapidly from the shore, and though unwalled is defended by a fort. A brisk coasting-trade is carried on by the inhabitants. Near Algeciras were fought two naval engagements in July, 1801. In the first the English admiral Saumarez failed in an attack on the French fleet, which was strongly posted in the bay under the protection of the batteries on shore (6 July), but in the second he defeated the combined French and Spanish fleets (12 July). Pop. 13,000.

Alger, Cyrus, an American inventor: b. West Bridgewater, Mass., 11 Nov. 1781; d. Boston, 4 Feb. 1856. He learned the iron foundry business, and in 1809 established himself in South Boston, where he soon made himself widely known by the excellence of the ordnance he manufactured. He supplied the United States government with a large quantity of cannon-balls during the War of 1812; produced the first gun ever rifled in America, as well as the first perfect bronze cannon; and supervised the casting of a mortar which was the largest gun of cast-iron that had then been made in the United States. Subsequently he made improvements in the construction of time fuses for bomb-shells and grenades; patented a method of making cast-iron chilled rolls; and was the original designer of the cylinder stove.

Alger, Horatio, an American writer of juvenile books: b. Revere, Mass., 13 Jan. 1834; d. Natick, Mass., 18 July 1899. He graduated at Harvard in 1852, settled in New York in 1866, and became interested in the condition of self-supporting boys, described in his series of more than 50 books, including 'Ragged Dick,' 'Tattered Tom,' 'Luck and Pluck,' which became very popular. Other works: 'Nothing to Do: A Tilt at Our Best Society,' a poem (1857); 'Helen Ford,' a novel (1860); a series of juvenile biographies of Webster, Lincoln, Garfield, etc.; and 'The Young Salesman' (1896).

Alger, Russell Alexander, an American merchant, capitalist, and politician: b. Lafayette, O., 27 Feb. 1836. He served in the Civil War, rising from a captaincy to the rank of brevet major-general of volunteers. He acquired a large fortune in western enterprises, particularly the lumber business. He was governor of Michigan from 1885 to 1887; a candidate for the Republican presidential nomination in 1888; commander-in-chief of the Grand Army of the Republic (1889–90); and became secretary of war in President McKinley's cabinet in 1897. Almost from the beginning of the Spanish-American war of 1898 he was the object of much public censure for alleged shortcomings in the various bureaus in his department, and this pressure became so strong and widespread that he resigned his office in 1899 after an investigation committee had exonerated him. In 1901 he published 'The Spanish-American War.'

Alger, William Rounseville, Unitarian clergyman: b. Freetown, Mass., 30 Dec. 1822; d. Boston, Mass., 7 Feb. 1905. Graduated at Harvard Theological School 1847; filled pastorates in Roxbury, Mass., Boston; New York, Denver, Chicago, Portland, Me. Works: 'Poetry of the Orient' (1856); 'Critical History of the Doctrine of a Future Life' (1861); 'Genius of Solitude' (1861); 'Friendships of Women' (1867); 'Life of Edwin Forrest' (2 vols. 1878); 'Symbolic History of the Cross' (1881).

Alge'ria, a French colony in north Africa, having on the north the Mediterranean, on the east Tunis, on the west Morocco, and on the south (where the boundary is ill-defined) the Desert of Sahara; area, 122,878 sq. m., or including the Algerian Sahara, 257,000. The country is divided into three departments — Algiers, Oran, and Constantine. The coast-line is about 550 m. in length, steep and rocky, and though the indentations are numerous the harbors are much exposed to the north wind. The country is traversed by the Atlas Mountains, two chains of which — the Great Atlas, bordering on the Sahara, and the Little, or Maritime Atlas, between it and the sea — run parallel to the coast, the former attaining a height of 7,000 feet. The intervals are filled with lower ranges, and numerous transverse ranges connect the principal ones and run from them to the coast, forming elevated table-lands and enclosed valleys. The rivers are numerous, but many of them are mere torrents rising in the mountains near the coast. The Shelif is much the largest. Some of the rivers are largely used for irrigation, and artesian wells have been sunk in some places for the same purpose. There are, both on the coast and in the interior, extensive salt lakes or marshes (*shotts*), which dry up to a great extent in summer. The country bordering on the coast, called the Tell, is generally hilly, with fertile valleys; in some places a flat and fertile plain extends between the hills and the sea. In the east there are *shotts* that sink below the sea-level, and into these it has been proposed to introduce the waters of the Mediterranean. The climate varies considerably according to elevation and local peculiarities. There are three seasons: winter from November to February, spring from March to June, and summer from July to October. The summer is very hot and dry. In many parts of the coast the temperature is moderate and the climate so healthy that Algeria is now a winter resort for invalids.

The chief products of cultivation are wheat, barley, and oats, tobacco, cotton, wine, silk, and dates. Early vegetables, especially potatoes and pease, are exported to France and England. A fibre called *alfa*, a variety of esparto, which grows wild on the high plateaus, is exported in large quantities. Cork is also exported. There are valuable forests, in which grow various sorts of pines and oaks, ash, cedar, myrtle, pistachio-nut, mastic, carob, etc. The Australian *Eucalyptus globulus* (a gum-tree) has been successfully introduced. Agriculture often suffers much from the ravages of locusts. Among wild animals are the lion, panther, hyæna, and jackal; the domestic quadrupeds include the horse, the mule, cattle, sheep, and pigs (introduced by the French). Algeria possesses valuable minerals, including iron, copper, lead, sulphur, zinc, antimony, marble (white and red), phosphate, and lithographic stone.

The trade of Algeria has greatly increased under French rule, France, Spain, and England being the countries with which it is principally carried on, and three fourths of the whole being with France. The exports (besides those men-

tioned above) are olive oil, raw hides, wood, wool, tobacco, oranges, etc.; the imports, manufactured goods, wines, spirits, coffee, etc. The manufacturing industries are unimportant, and include morocco leather, carpets, muslins, and silks. French money, weights, and measures are generally used. The chief towns are Algiers, Oran, Constantine, Bona, and Tlemcen. There are about 2,000 miles of railways opened; there is also a considerable network of telegraph lines.

The two principal native races inhabiting Algeria are Arabs and Berbers. The former are mostly nomads, dwelling in tents and wandering from place to place, though a large number of them are settled in the Tell, where they carry on agriculture and have formed numerous villages. The Berbers, here called Kabyles, are the original inhabitants of the territory and still form a considerable part of the population. They speak the Berber language, but use Arabic characters in writing. The Jews form a small but influential part of the population. Various other races also exist. Except the Jews all the native races are Mohammedans. There are now a considerable number of French and other colonists, provision being made for granting them concessions of land on certain conditions. There are over 260,000 colonists of French origin in Algeria, and over 200,000 colonists natives of other European countries (chiefly Spaniards and Italians). Algeria is governed by a governor-general, who is assisted by a council appointed by the French government. The settled portion of the country, in the three departments of Algiers, Constantine, and Oran, is treated much as if it were a part of France, and each department sends two deputies and one senator to the French chambers. The rest of the territory is under military rule. The colony costs France a considerable sum every year. Pop. (1902) estimated about 4,500,000.

Industries.— The wine business at the present day constitutes the largest industry in Algeria. Until very recently it had been going up by leaps and bounds, many large fortunes having been made. During 1900 and 1901, however, the price of wine steadily decreased on account of the abnormal yield in France, and great losses were consequently incurred by those who were forced to dispose of their vintage. In 1902, the crops in France having been greatly damaged by late frosts, wet, and severe hailstorms, the wine-growers partially recouped their losses. The amount of wine exported from Algeria during 1897 was 781,558 gallons; in 1898, 796,049 gallons; in 1899, 945,879 gallons; and in 1900, 549,131 gallons. The other principal products are alfa, cereals, cork, vegetable hair, locust beans, olive oil, fruits, and vegetables, and Italian pastes. The area which alfa occupies in the three departments of Algeria is estimated at more than 12,000,000 acres. The principal district, called the « Alfa Sea,» is 210 miles by 95 miles and is bounded on the N. by the Tell, on the W. by Morocco, on the S. by the mountains of Ksowes, and on the E. by the Hodna. The producing area is much greater than that actually cut; nevertheless, in order to prevent the loss which would result from bad working, the governor-general issued an order in 1888 limiting the cutting, sale, and export of alfa. The average production of an acre of alfa is estimated at 8 cwt. after drying and sorting. In 1900 Algeria exported 1,650,235 cwt. of wheat, 1,188,153 cwt. of oats, 1,773,509 cwt. of barley, and 27,496 cwt. of maize. The barley is much in demand in Europe for malting purposes. Algeria produces excellent hard wheat, giving a flour rich in gluten, and consequently very good for the manufacture of Italian pastes and semolina. This industry is annually increasing; the existing works are enlarging and improving their machinery, modern methods of shop management are being introduced, and the output of the various establishments to-day rivals that of France and other countries.

Consult: Wilkin, ‹ Among the Berbers of Algeria ›; Nugent, ‹ A Land of Mosques and Marabouts ›; Morell, ‹ Algeria ›; Playfair, ‹ The Scourge of Christendom.›

Algerine War. See Barbary Powers, U. S. Treaties and Wars With the.

Alghero, or **Algheri**, a fortified town and seaport on the W. side of the island of Sardinia, in the province of Sassari, and 17 m. S.W. of the town of that name. The port is not good, but 7 m. W. of it is Porto Conte, the best harbor in the island. The town is the seat of a bishop and possesses a handsome cathedral. The inhabitants are mainly employed in wine-growing and coral-fishing. Pop. 10,500.

Algiers (French, *Alger*), a city and seaport on the Mediterranean, capital of the French colony of Algeria, is situated on the W. side of the Bay of Algiers. It stands on the slope of a hill facing the sea, from which its array of white houses, rising in the form of an amphitheatre, presents an imposing appearance. The old town, which is the higher, has an Oriental aspect. Its crowning point is the Casbah, or ancient fortress of the deys, about 500 feet above the sea. Its streets are narrow, crooked, and dirty. The houses are strong, prison-like edifices, with iron-grated slits for windows, looking into central quadrangles entered by a low doorway. The modern town, which occupies the lower slope and spreads along the shore, is handsomely built, with broad streets adorned with arcades and having elegant squares. It contains the government buildings, the barracks, the commercial warehouses, the residences of the governor-general and the government officials, and the superior courts of justice. The Place du Gouvernement and the Place Bresson here are the two chief squares of the city. The fine Boulevard de la République runs along the sea-front, overlooking the bay and harbor. Algiers is the seat of an archbishop. It has a cathedral and a number of churches (one of them being an English church) and mosques. There are schools of law, medicine, science, and letters, and a lyceum; also a library and museum. It is defended by sea-batteries and other works. The French have been at great expense in improving the port and providing docks. Pop. about 100,000.

Algoa Bay, a bay on the S.E. coast of Cape Colony, Africa; about 420 m. E. of the Cape of Good Hope. At its entrance, formed by Cape Woody on the N.E. and Cape Recife on the S.W., it has a width of 33 miles. Its shelter is very valuable, as there is no other refuge for ships during the N.W. gales. The

usual anchorage is off Port Elizabeth, at the mouth of the Baakens, where there is now a large and increasing trade.

Algol', a star in the constellation Perseus (head of Medusa), remarkable as a variable star, changing in brightness from the second to the fourth magnitude.

Algo'ma, a district of Canada, on the N. side of Lake Superior, forming the N. W. portion of Ontario, rich in silver, copper, iron, etc.

Algona, Iowa, city and county-seat of Kossuth County, on the Iowa Cent., Chicago & N. W., and Chicago, M. & St. P. R.R.'s about 123 m. N. by W. of Des Moines, on a branch of the Des Moines River. The city has four banks, handsome public buildings, and flourishing manufactures of foundry and machine-shop products, wooden-ware, bricks and tiles. Pop. 3,000.

Algonkian System, the name given in the United States to a great series of rocks that succeeds the basal system of the Archæan and is overlaid by the strata of the Palæozic system. The rocks of the Algonkian system are developed on an enormous scale in the Lake Superior region, where they comprise limestones, sandstones, quartzites, shales, slates, and schists, all more or less disturbed and bearing evidence of having been subjected to metamorphism. They also include dikes and beds of igneous rocks, and great copper and iron ore deposits, which are among the richest in the world. A few fossil remains have been found, but little is known as to the life conditions during the Algonkian period.

Algonquian, or **Algonkian Stock**, a North American group once comprising forty or more separate languages, and embracing a larger area than any other on the continent, stretching in a solid block from Labrador to the Rockies and from Hudson's Bay to Pamlico Sound and the Cumberland River at least, except the enclaves of Iroquois in and around New York State, and of Beothukan in Newfoundland. Outlying tribes were the Shawnee or Shawano to the south; and to the west the Cheyenne and Arapahoe, which clove their way through the heart of the Sioux across the Missouri and into the Black Hills region, and later to Colorado and Wyoming, their advance westward being checked by the Shoshone group. They numbered several hundred tribes, or « villages," entirely independent; many in which several such villages were grouped together; and several confederacies of tribes united in a loose bond for mutual aggression or defense, though never with any real central government. The chief confederacies were the Abnaki or Abenaki of Maine and New Brunswick; the Pennacook of New Hampshire, and the adjacent parts of Maine and Massachusetts; the Powhatan of Virginia and Maryland; the Illinois or Illini of that region and adjacent Wisconsin, Iowa, and Missouri; the Siksika (Blackfeet, etc.) of northern Montana and adjacent Canada; the Cheyenne and Arapahoe, already mentioned; and the Sac and Fox, first at the mouth of the Ottawa, then in northern Wisconsin. (See each title.) Of the individual tribes, the most important remaining were the Micmac, Amalecite, Massachuset, Wampanoag, Narraganset, Nipmuc, Pequot, Mohegan, Mohican, Metoac, and Wappinger on the North Atlantic coast; Munsi, Leni-Lenape or Delaware, Shawano, Nanticoke, Conoy, Mattamuskeet, on the South Atlantic coast; Nascapi, Montagnais, Algonquin, Ottawa, Muskegon, Cree, Ojibwa, Misisaga, Miami, Piankishaw, Kickapoo, Pottawotomi, Menomini, in the interior; and Atsina in the West. Tradition places the original home of all these tribes on the North Atlantic coast.

From their being the first to come in contact with the English settlers, and the history of English settlement for two centuries being a steady record of fierce conflict with and bloody reprisals from and on them, more is known of their minor names and those of their great chiefs — Powhatan, Opechancanough, Philip, Pontiac, Tecumseh, Black Hawk, etc.— than of any others except the Iroquois, and their languages are better studied.

Constant wars with the English, French, and Dutch colonists depleted their numbers. Filled at first with the idea of freeing the soil from the whites, they afterward degenerated into mere mercenaries, fighting on either side for revenge or gain. After the War of 1812, in which they took the side of the British, the United States government resolved to send them as far west as possible. After 1840 few of them remained east of the Mississippi. In Canada they were not removed from their homes, but were limited as to territory. War and disease have thinned their number until only about 43,000 remain in the United States, and 38,000 in Canada; there are a few hundred refugees in Mexico.

Algonquin (properly **Algomekin**, « other-siders ») a once powerful Indian tribe along the Ottawa River and Lake Nipissing, Canada. Decimated by the Iroquois, some of them with other Indian waifs took refuge along the Upper Lakes and assumed the name of Ottawas (q.v.), bringing forth the greatest Indian of history, the mighty Pontiac (q.v.); others kept their name and were protected by the French in mission villages. It was French missionaries who discovered almost at their first coming that the Algonquin language was a type common to what is now called the Algonquian stock. The chief body of the remaining tribe numbers nearly 1,000, in villages of Quebec and Ontario; about 250 more are confederated with the Iroquois at Gibson, Ont., and Lake of Two Mountains, Que.

Alhama, a town of Spain, on the Motril; 25 m. S.W. of the town of Granada. This place is celebrated for its warm medicinal (sulphur) baths and drinking-waters, and also for its romantic situation between craggy mountains. The principal bath was a Moorish edifice, the smaller was circular in form and probably a Roman erection. The town was thrown completely into ruins by an earthquake shock in 1884. Washington Irving, in his ‹ Chronicle of Granada,› gives a spirited account of the taking of Alhama, « the key of Granada," from the Moors, by Rodrigo Ponce de Leon, Marquis of Cadiz, in February 1482.

Alhambra (*Kelât-al-hamrah*, the red castle), the citadel of Granada when that city was one of the principal seats of the empire of the Moors in Spain. The wall which surrounded it still stands flanked by many towers, and has a cir-

cuit of 2¼ miles. Within it were included several important buildings, besides dwelling-houses; but the building to which the celebrity of the site is due is the Alcazar, or royal palace of the kings of Granada, seated on the northern brow of a lofty eminence which commands a full view of the city of Granada, and, beyond it, of a charming country, bounded in the distance by a line of hills. It is a place equally interesting to the artist, the antiquarian, and the historian. The erection of the greater part of the present building seems to have occupied almost the whole of the first half of the 14th century. It consists mainly of two oblong rectangular courts, the one (which was seriously damaged, if not ruined, by fire in September 1890), called the court of the Fish-pond or of the Myrtles, 138 by 74 feet, and terminating at its northern end in an apartment 35 feet square, richly ornamented: the other, called the Court of the Lions, 115 by 66 feet, and so named from the white marble fountain in the centre supported by twelve lions. An exact repetition of this court, on two thirds of the scale of the original, was made by Mr. Owen Jones in the Crystal Palace. It is surrounded by an arcade, with small pavilions at each end, consisting of 128 columns supporting arches of the most delicate and elaborate finish, still very perfect and retaining much of their original beauty. From the character of many of the arches in various portions of the palace they are most appropriately called stalactitic. They are formed on a peculiar system with plaster bricks of various forms in a manner universally adopted in the buildings of the Moors. The construction of the arches is remarkable for its simplicity. Over the columns, which are of white marble, and which were probably gilded, are brick piers carrying rough brick arches; above these tiles are placed diagonally, forming diamond-shaped open work, running through the thickness of the walls, and a brest-summer of timber supporting the weight above. To these rough arches are attached the various enrichments, and against the tiles are placed the perforated plaster ornaments which give a singularly light appearance to the arches, and create very beautiful effects from the rays of light cast through the openings on the wall behind them.

Alhambra, The, by Washington Irving. (1832. Revised, enlarged, and rearranged, 1852.) This Spanish Sketch-Book grew out of the experiences and studies of Irving while an actual resident in the old royal palace of the Moors at Granada. Many of the forty sketches have their foundation only in the author's fancy, but others are veritable history.

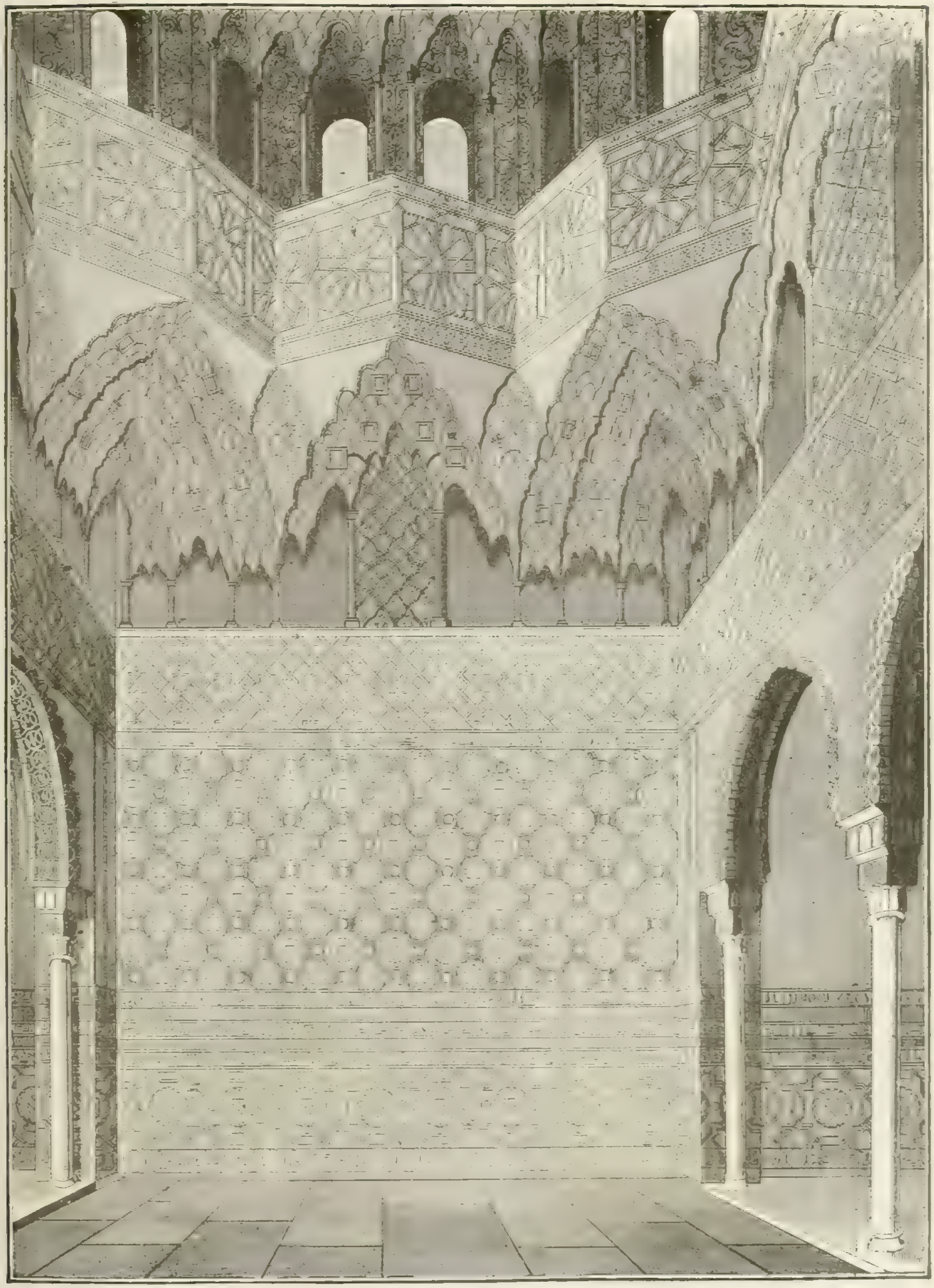
Ali, â'lē, cousin and son-in-law of Mohammed, the first of his converts, and the bravest and most faithful of his adherents; b. 602; d. 661. He married Fatima, the daughter of the prophet, but after the death of Mohammed (632) his claims to the caliphate were set aside in favor successively of Abu-Bekr, Omar, and Othman. On the assassination of Othman, in 656 A.D., he became caliph, and after a series of struggles with his opponents, including Ayesha, widow of Mohammed, finally lost his life by assassination at Kufa. A Mohammedan schism arose after his death, and has produced two sects. One sect, called the Shiites, put Ali on a level with Mohammed, and do not acknowledge the three caliphs who preceded Ali. They are regarded as heretics by the other sect, called Sunnites. The Maxims and Hymns of Ali are yet extant. See CALIPH.

Ali, pasha of Yanina, commonly styled **Ali Pasha,** a bold and able, but ferocious and utterly unscrupulous Albanian, b. 1741, son of an Albanian chief who was deprived of his territories by rapacious neighbors. By his enterprise and success and entire want of scruple he got possession of more than his father had lost, making himself master of a large part of Albania, including Yanina, which the Porte sanctioned his holding, with the title of pasha. As a ruler he displayed excellent qualities, putting an end to brigandage and anarchy, making roads, and encouraging commerce. He extended his sway by subduing the brave Suliotes of Epirus, whom he conquered in 1803 after a three years' war. Aiming at independent sovereignty, he intrigued alternately with England, France, and Russia. Latterly he was almost independent of the Porte, which at length determined to put an end to his power; and in 1820 Sultan Mahmoud pronounced his deposition. Ali resisted several pashas who were sent to carry out this decision, only surrendering at last in 1822 on receiving assurances that life and property should be granted him. Faith was not kept with him, however; he was killed and his head cut off and conveyed to Constantinople, while his treasures were seized by the Porte.

Alias, in law, a term used to indicate the names under which a person who attempts to conceal his true name is ascertained to have passed during the successive stages of his career. An alias writ is a writ issued where one of the same kind has been issued before in the same cause.

Ali Baba, the principal figure in the famous 'Arabian Nights' Entertainments' tale of 'Ali Baba and the Forty Thieves.' He overhears the thieves opening the door of their cavern by the use of the magic words «Open sesame.» He does the same in their absence and appropriates as much of their wealth as he can carry. Cassim, his brother, enters the cave later, but having forgotten the magic word is presently found by the robbers and killed. They make an attempt to slay Ali Baba, but are defeated by the slave Morgiana, who pours boiling oil in the jars in which the robbers are hidden.

Ali Bey, a ruler of Egypt: b. in the Caucasus in 1728, was taken to Cairo and sold as a slave, but having entered the force of the Mamelukes, and attained the first dignity among them, he succeeded in making himself virtually governor of Egypt. He now refused the customary tribute to the Porte and coined money in his own name. In 1769 he took advantage of a war in which the Porte was then engaged with Russia, to endeavor to add Syria and Palestine to his Egyptian dominion, and in this he had almost succeeded when the defection of his own adopted son Mohammed Bey drove him from Egypt. Joining his ally Sheikh Daher in Syria, he still pursued his plans of conquest with remarkable success, till in 1773 he was induced to make the attempt to recover Egypt with insufficient means. In a battle near Cairc



SECTION IN PALACE—Alhambra

his army was completely defeated and he himself taken prisoner, dying a few days afterward either of his wounds or by poison.

Alibi, in law, a plea that the person accused of having committed a crime was elsewhere at the time when the breach of the law occurred. If he substantiate this, he is said to prove an alibi. In Scotland the defendant must give notice of a special defense of alibi, stating where he was when the crime was committed. In England and the United States this notice is not required. If the accused can make it appear that at the time when the crime charged is alleged to have been committed (it being of a nature to require his personal presence) he was in another place, his innocence will be established, because of the obvious impossibility of the same person being in two places at once. This species of defense is constantly resorted to in trials for crime. One of the principal rules in the application of this species of evidence is that the time relied on, and in which the value of the evidence mainly consists, must correspond closely with the time at or during which the offense is proved to have been committed. If, time having been fixed to a particular day, hour, and minute, the person accused can show that at that exact time he was in another place, his innocence is at once made apparent.

Alicante, a seaport of Spain; capital of the province of Alicante; the ancient Lucentum. It is situated at the foot of a cliff 850 feet high, crowned by the fort of Santa Barbara. It has one of the best harbors on the Mediterranean, and carries on a considerable trade, exporting wine, fruit, esparto grass, etc. It was bombarded in 1873 by two vessels sent out by Cartagena insurgents. Prof. Freeman, the English historian, died here in 1892. An American consul has been stationed at Alicante for some years. Pop. (1900) 50,495.

Alicata, or **Licata**, â-lē-kä'tâ, lē-kä'tâ, the most important commercial town on the south coast of Sicily, at the mouth of the Salso, 24 m. E.S.E. of Girgenti, with a considerable trade in sulphur, grain, wine, oil, nuts, almonds, and soda. It occupies the site of the town which the tyrant Phintias of Acrogas erected and named after himself, when Gela was destroyed in 280. Pop. 15,966.

Alice's Adventures in Wonderland, by Lewis Carroll (Charles L. Dodgson). Alice, a bright little girl, is the heroine of the tale and by following an extraordinary rabbit into a rabbit hole, she finds herself in a land where unreal things seem real. Her mistakes at first barely save her from drowning in her own tears; but she presently meets many queer animal friends besides a crusty old Duchess, a mad Hatter, a sleepy Dormouse, and a March Hare, with whom she has strange experiences, and finally they take her to play croquet with the Queen of Hearts. During a trial by jury at the court of the Queen, Alice becomes excited and calls every one there nothing but a pack of cards. As they rise into the air and come flying down upon her, she awakes to find herself on a bank where she had fallen asleep. A sequel to the story is 'Through the Looking-Glass,' (1871).

Alien, any person not legally within the jurisdiction of a country as one of its citizens. By the laws of the United States the children of male citizens, whether born within the country or abroad, are held to be citizens; but all other foreign-born individuals are aliens until made citizens by naturalization. In the United States aliens are nominally prohibited from acquiring title to real estate, but in practice they may own lands subject to proceedings by the State to determine the fact of alienage; and, moreover, in nearly all the States there are special provisions removing such restrictions from resident aliens who are in the course of naturalization. The rights of aliens to hold personal property and carry on trade are the same as those of citizens. In time of war, however, aliens belonging to the country of the enemy cannot make contracts with citizens or resort to the courts except as accorded such privileges by special treaties. In the United States, if an alien dies without making a will and without leaving any known heirs, his estate immediately vests in the State without office found. An alien may sue and be sued; he may be tried for crime, and has a right to labor and to trade. No State can pass a law refusing rights to aliens which are secured by treaty. A law of this kind would be void, for the reason that every treaty made by the authority of the United States is superior to the constitution and laws of any State. Naturalized aliens are subject to political disabilities as follows: They are permanently disqualified for election as President or Vice-President, and cannot become members of the National Senate or House of Representatives until they have been citizens for nine or seven years respectively. In Great Britain there is no discrimination whatever between aliens and subjects as far as property rights are concerned. It is held by British law that the children of aliens born in Great Britain are natural-born subjects. In all Christian countries the tendency of legislation concerning aliens shows increasing liberality, although it is still the policy of the Latin nations, in their colonies, to limit materially the trade advantages of foreigners.

Alien and Sedition Acts, in American political history, four acts passed by the Federalist party in Congress in the summer of 1798, under John Adams, which were the immediate cause of the first nullification proceedings in the South (see KENTUCKY RESOLUTIONS; NULLIFICATION; VIRGINIA RESOLUTIONS), and one of the causes which alienated enough votes from the Federalists to drive them out of power sooner than was inevitable. (For the genesis of the alien acts see also AMERICAN PARTY.) The embittered exiles who flocked here from 1790 on were doubly obnoxious to the Federalists: both as scurrilously offensive journalists, oftentimes, and as hostile to all attempts to punish France for her wanton aggressions on American commerce. In 1797 the House was Republican, the Senate Federalist; the latter attempted to pass measures for defense against France, which the former steadily voted down. At length, in 1798, the publication of the "X. Y. Z." correspondence, showing the rottenness of the French Directory, shamed the defenders of France and incensed the moderates into supporting the Federalists: who, having now a majority in both houses, first enacted three laws concerning aliens: (1) 18 June, making the residence be-

fore naturalization fourteen years instead of five, and the term after declaration of intentions five instead of three; alien enemies not to be allowed naturalization; registration of all aliens on arrival, under penalties, and entry on such register the only proof admitted on applying for naturalization. (2) 25 June, empowering the President for two years to order out of the country any aliens he thought dangerous or engaged in conspiracies. (3) 6 July, legalizing the apprehension or deportation of all resident aliens when war was declared against the United States. These acts were denounced by the Republicans on three grounds, two of State rights and one general: as invading the Constitutional rights of the States to permit such immigration as they chose up to 1808 (really intended to apply only to slaves); that it assumed national powers over persons under the jurisdiction of their States; and that it violated the right of trial by jury. It was on these points that Jefferson and Madison drew up the Kentucky and Virginia legislative resolutions; the former of which, on its repetition in 1799, named nullification as the proper remedy. Second, on 26 June, Lloyd of Maryland introduced a bill (1) declaring France an enemy of the United States, and any one who should uphold her or give her aid or comfort guilty of high treason; (2) defining treason; (3) imposing $5,000 fine and six months' to five years' imprisonment on any one conspiring to oppose or impede United States measures, intimidate United States officers, stir up insurrection, etc.; (4) imposing a fine of not over $2,000 and imprisonment for not over two years for any utterance or writing tending to justify France, or to defame United States officials as hostile to popular liberties, etc. It passed the Senate by a heavy majority; the House made important changes in it and passed the altered bill by a scratch. These changes were: (1) Canceling the first two sections altogether; (2) substituting for the fourth, the publishing or printing any false, scandalous, or malicious writings to bring the Government, Congress, or President into contempt or disrepute, excite popular hostility to them, incite resistance to United States laws or encourage hostile designs against the United States, etc. To these, which gave Federal judges power to make any opposition to the ruling party a felony, Bayard of Delaware got two clauses added which drew their teeth: the first making the truth a good defense and juries the judges of the fact; the second restricting the term of operation to 4 March 1801 — that is, till a new administration came in, so that it should expire with the Federalists if they went out, and the Republicans thus lose the *éclat* of repealing it. It would naturally be supposed that the Alien Acts, which affected only a few foreigners and no internal liberties, and which as a fact remained entirely unenforced, would have caused little commotion in the Republican party; and that the Sedition Act, which struck at all liberty of free speech or publication, and was contrary to the very basis of free government, and under which at least six prosecutions and most scandalous performances of one Federal judge took place, would have provoked almost a civil war. The facts are an instructive historical lesson against transferring the ideas of one age to another. The Republicans disliked the use of prosecutions under the Sedition Act as a party weapon, and resented Judge Chase's partisan decisions; but it was only as directed against themselves, not as against civil liberty, that they reprobated it,— neither party had attained to that ideal,— and their chief rhetoric and defiance was directed against the harmless acts which tried to prevent their supporting France. It was in crystallizing the spirit of State resistance to national power that the acts have their main importance.

Alienation of Estates, comprises any method whereby estates are voluntarily resigned by one and accepted by another, whether that be effected by sale, gift, marriage settlement, devise, or other transmission of property by the mutual consent of the parties. 2 Bl. Com., § 287; 55 N. J. L. 417. The term alienation is particularly applied to absolute conveyances of real property. 1 N. Y. 290, 294.

Alienations by deed may be by conveyances at common law; which are either original or primary, being those by means of which the benefit or estate is created or first arises; or derivative or secondary conveyances, being those by which the benefit or estate originally created is enlarged, restrained, transferred, or extinguished; or they may be by conveyances under the statute of uses. The original conveyances are the following: feoffment, gift, grant, lease, exchange, partition. The derivative are release, confirmation, surrender, assignment, defeasance. Those deriving their force from the statute of uses are covenants to stand seized to uses, bargain and sale, lease and release, deeds to lead or declare the uses of other more direct conveyances, deeds of revocation of uses. 2 Bl. Com. ch. 20; 2 Washb. Real Prop. 600.

Alienist. See PSYCHIATRY.

Ali Ferrough Bey, Turkish diplomatist: b. Constantinople, 1865. After serving as secretary of embassy at Paris, London, and Bucharest, as well as councilor of embassy at St. Petersburg, he was promoted to the post of minister-plenipotentiary and envoy-extraordinary to the United States. Besides histories of Arabia and Turkey he has published 'Public and Private International Law.'

Aligarh, or **Alighur,** a town in India, in the Northwest Provinces, in the executive district of the same name, 53 m. N. of Agra. Aligarh is merely a fortress, the town being Coel, distant about two miles and connected with Aligarh by a beautiful avenue. It was formerly of importance and was more recently one of Dowlet Rao Sindia's principal depots for military stores. The fort is square, with round bastions, ditch, and glacis, and a single entrance, protected by a strong ravelin. It was taken in 1803 by Lord Lake, Sindia's commander, Perron (a Frenchman) having previously surrendered, and the whole district was then added to the British possessions. Since that time the fort has been much improved, and the town made the station of a civil and judicial establishment. Pop. of Coel (1901) 70,127.

Aliment. See FOOD; NUTRITION.

Alimentary System, or **Gastro-intestinal System,** is the collection of organs in animals that is chiefly concerned in the processes of digestion and nutrition. It is, in man, a highly complicated tube of some thirty or more feet in length, beginning at the mouth, then the

pharynx, the œsophagus leading into the stomach, which organ is a dilated and pouch-like portion of the tube. From the stomach the tube is narrowed into the small intestine, there being some twenty to twenty-five feet of this, divided into three parts, the duodenum, the jejunum, and the ileum. These three parts are distinguished the one from the other by means of their minute histological structure. At the end of the ileum the tube once more dilates, a pouch is formed, the appendix vermiformis being situated here, and the large intestine or colon begins. This passes up the right side of the abdomen, constituting the ascending colon; crosses over under the liver high up in the abdomen, about on the level of the umbilicus, the transverse colon; then descends on the left side, to turn at the lower iliac region abruptly backward and into the centre of the body to form the short rectum. The tube terminates at the anus, guarded by two circular muscles known as the sphincters. The number of accessory glands and organs that empty their secretions into the intestinal system is very great. The most important are the salivary glands in the mouth, the digestive glands of the stomach, the liver and pancreas, the secretions of which enter by a common duct just below the stomach, and the intestinal glands. Mucous glands are found throughout the entire length of the intestinal system.

The structure of the different portions of the tube is similar, but variations in function produce slight modifications, especially in the muscular coats. In general there is a layer of mucous membrane on the interior of the canal; this is surrounded by a connective-tissue supporting framework, and is further strengthened by a varying amount of unstriped muscular tissue. The details of structure will be considered in the descriptions of the several organs. (See INTESTINE; STOMACH.) The work of the alimentary system in the complicated chemical processes of digestion is more fully described in various other articles. See DIGESTION; METABOLISM; NUTRITION.

Alimony, in law, the allowance, awarded out of her husband's estate, to which a wife is entitled on separation or divorce. Jurisdiction in this matter in England rested with the ecclesiastical court until 1857, when it was conferred upon a court of divorce. In the United States it is vested in the courts of equity. Alimony may be granted by the court during litigation, in which case it is known as *pendente lite* (during the suit); or at the conclusion of the suit, when it is called permanent. The former enables the wife to pursue the litigation, whether proceedings have been brought by or against her. The amount granted lies within the discretion of the court and depends upon a variety of considerations, and is governed by no fixed rules. The ability of the husband to pay is of most importance in determining the amount, and in estimating his ability his entire income will be taken into consideration, whether derived from his property or his personal exertions. So far as any general rule can be drawn from the decisions and practice of the courts, the proportion of the joint income to be awarded for permanent alimony is said to range from one half to one third, while in case of alimony pending suit it is not usual to allow more than one fifth, and usually a smaller proportion will be allowed out of a large estate than out of a small one. Permanent alimony is a periodical allowance awarded to the wife if the termination of the suit is favorable to her. By a writ of *ne exeat* (let him not depart) the court can prevent the husband from leaving the State without leaving sufficient security for payment. The writ of *ne exeat* has been expressly abolished in many of the States of the Union, but its place has been filled in almost every instance by a similar procedure. In New York a system of arrest and bail has been substituted for the writ. If the husband should remove to another State the wife can enforce her claim in the Federal courts. See MARRIAGE AND DIVORCE.

Alis, Hippolyte Percher, al-ē, ip-o-lēt pär shā, French novelist and journalist: b. Couleuvre, 7 Oct. 1857. Besides journalistic work, he has written several «naturalistic» novels, including ‹Hara-Kiri› (1882); ‹A Daughter of the Soil› (1885); ‹Some Foolish People› (1889).

Alishan, Leo M., äl-ē-shan', Armenian poet and historian: b. Constantinople, 30 July 1820; studied in Venice, took orders there 1840, was given a chair in the College Raphael, and made its director 1848; head of the Armenian college in Paris 1858, director of St. Lazare in Venice 1865. Armenians regard him as their leading poet. His complete poems were published 1857–67. He issued ‹Popular Songs of the Armenians› (1867); ‹Historical Monographs› (1870); ‹History and Geography of Armenia› (1885), seized and suppressed by the Turkish authorities.

Alisma'ceæ, the water-plantain family. *Sagittaria* (arrowhead). See ARROWHEAD; WATER PLANTAIN.

Al'ison, Rev. Archibald, Scottish theologian and writer on æsthetics: b. Edinburgh, 1757; d. there 1839. Studied at Glasgow and Oxford, entered the English Church, and (1800) settled as the minister of an Episcopal chapel at Edinburgh. He published two volumes of sermons, and a work entitled ‹Essays on the Nature and Principles of Taste› (1790), in which he maintains that the beauty of material objects depends upon the associations connected with them.

Al'ison, Sir Archibald, Scottish lawyer and writer of history, son of the above: b. Shropshire, 1792; d. near Glasgow, 1867. He was educated at Edinburgh University, and in 1814 was admitted to the Scottish bar. After several years passed in Continental travel he was appointed advocate-depute, which post he held till 1830. In 1832 he published ‹Principles of the Criminal Law of Scotland,› and in 1833 ‹The Practice of the Criminal Law.› Was appointed sheriff of Lanarkshire in 1834, and retained this post till his death. He was made a baronet in 1852. His chief work, ‹The History of Europe, from 1789 to 1815,› was first issued in 10 vols. 1833–42, the narrative being subsequently brought down to 1852, the beginning of the second French empire.

Alison, Sir Archibald, Jr., Scottish general: b. Edinburgh, 21 Jan. 1826. He was a son of the preceding and was educated at Glasgow and Edinburgh, and after entering the English army served in the Crimea and India.

He distinguished himself while second in command of the Ashantee expedition, 1873–74, and also in the war in Egypt in 1882, becoming lieutenant-general in that year. He retired in 1893.

Aliza'rin (from *alizari*, the commercial name of madder in the East), a substance having the formula $C_{14}H_6O_2.(OH)_2$, formerly obtained from the root of the madder (*Rubia tinctoria*), but now artificially produced from coal-tar and the refuse from the distillation of crude petroleum. It is used as a dye, for producing the color known as "turkey red." Alizarin is of interest to the chemist not only on account of its industrial importance, but also because it was the first vegetable coloring matter to be produced artificially; and the year 1868, in which its synthesis was effected by W. H. Perkin, therefore marks the beginning of a new era in industrial chemistry. In the manufacture of alizarin, anthracene ($C_{14}H_{10}$) is first prepared from coal-tar, and by oxidation (which it readily undergoes under the influence of potassium bichromate or other oxidizing agent) is transformed into anthraquinone, $C_{14}H_8O_2$. The next step is to sulphonate the substance so formed. Anthraquinone is remarkably stable toward sulphuric acid, but combination can be effected by strongly heating a mixture of the two, and a solution of mono- and disulphonic acids of anthraquinone is the result. The excess of sulphuric acid is then removed, and the sulphonic acids are heated with caustic potash to about 350° F. The mass gradually darkens till it becomes almost black, at which stage it dissolves in water with the formation of a rich purple solution, from which alizarin can be precipitated in abundance by the addition of sulphuric acid. A similar process was also devised by Perkin, in which the first step is the formation of dichloranthracene, $C_{14}H_8Cl_2$, by treating anthracene with chlorine. Subsequent treatment of this body with sulphuric acid gives anthraquinone disulphonic acid, $C_{14}H_6O_2(HSO_3)_2$. This is fused with potash, as described above, and the alizarin precipitated with sulphuric acid as before. Anthrapurpurin is formed, simultaneously with alizarin, in the processes given above. Its behavior as a dye is similar to that of alizarin, but it gives a brighter red. Pure alizarin, as obtained by sublimation, crystallizes in yellowish-red crystals, only slightly soluble in alcohol or water, but readily dissolving in alkalis. Chemically, alizarin is known as dioxyanthraquinone.

Alkahest, or **The House of Claës, The** (*'La Recherche de l'Absolu'*—The Search for the Absolute), is a striking novel by Honoré de Balzac. The central character, Balthazar Claës, is a wealthy chemist, the dream of whose life is to solve the mystery of matter. Gradually the quest becomes a fixed idea, for which money, family, health, sanity, are sacrificed, and Claës dies heart-broken and defeated. As foils to him stand his devoted wife and his eldest daughter Marguerite, noble women, the latter one of the finest creations of Balzac's genius. They sympathize sorrowfully yet tenderly with his ideal, and bear with true heroism the misery to which his mad course subjects them. The story belongs to that series of the Human Comedy known as « Philosophical Studies,» and appeared in 1834.

Al'kali (from the Arabic, *al*, «the,» and *qaliy*, «ashes»), a term originally used for the soluble part of «pot-ashes,» but since extended to include the hydrate or oxid of any of the metals lithium, sodium, potassium, cæsium and rubidium, or of the radical ammonium. The alkalis possess strongly basic properties, and (with the exception of ammonia) rapidly absorb carbon dioxid from the air, when moist, passing into the form of carbonates. They are all soluble in water, and nearly all of their compounds are also soluble. The real nature of the alkalis was first conclusively proved by Sir Humphry Davy when in 1807 he decomposed potash and soda by means of the electric current. Alkalis in concentrated solution exert a powerfully corrosive action on the skin, and even in very dilute solution they alter the color of certain vegetable infusions very markedly. This property is utilized for detecting free alkalis in solutions under examination, strips of bibulous paper impregnated with red infusion of litmus being moistened with the fluid to be tested. An exceedingly small amount of free alkali will transform the red color to a blue. The alkali metals are all monovalent.

The early chemist distinguished another class of substances, somewhat resembling the alkalis, as the «alkaline earths.» These include the oxids of calcium, strontium, and barium. The alkaline earths are basic in nature, and differ from the alkalis chiefly in being less soluble. Magnesium is sometimes included among the alkaline earths, but it falls more naturally into the zinc group. See ANTACID; SOILS.

Alkalim'etry, that branch of chemistry which treats of the quantitative estimation of alkalis present in a given solution. See ANALYSIS, CHEMICAL.

Alkaloids, organic bases, forming definite salts with acids and resembling in some respects the metals of the alkalis, hence the name. A number of basic nitrogenous compounds of marked physiological action and somewhat analogous in their chemical composition. It has been proposed to limit the word alkaloid to the group of basic nitrogenous principles found in plants, the somewhat similar bodies found in animals being termed ptomains (q.v.) and leucomains (q.v.). (See ANIMAL ALKALOIDS.) Some even class as alkaloids a series of feebly basic compounds prepared synthetically from the anilines, antipyrine, etc. Alkaloids are here considered in their strict sense as basic nitrogenous principles, products of the metabolism of plants.

Distribution.—Alkaloids are widely distributed throughout the plant kingdom; many plants contain them, and some plants contain a large number; opium, *Papaver somniferum*, for instance, contains a dozen or more alkaloids. The *Cinchona* family also contains many. In such cases, however, the alkaloids are, as a rule, very closely related in their chemical structure. Certain plant families contain many, others a few or none. Most of the alkaloids are found in the Dicotyledons, a few only are found in the Monocotyledons, Colchicum, and perhaps some of the *Liliaceæ*. The cryptogams do not seem to contain alkaloids in the true sense of the word, although ergot was supposed to contain some principles closely resembling alkaloids. The

Papaveraceæ, Solanaceæ, and *Ranunculaceæ* are particularly rich in alkaloids. The *Leguminoseæ, Rubiaceæ,* and *Umbelliferæ* contain many, while the large families of the *Compositæ* and *Labiateæ* contain very few. For the most part similar alkaloids are found in related plants, yet a few widely separated plants contain similar alkaloids, berberin being an example. As to their location in the plants themselves, alkaloids are found mostly in the fruit and seeds; many are found in the barks, and some in the roots. They are formed for the most part in the actively growing portions of the plant and are probably katabolic products of the plant metabolism. They are usually found in solutions combined with some plant acid in the cell sap, sometimes dissolved in oils or mucilage, and in many instances are stored up in secretory passages in the plant. As to the role that the alkaloids play in the plant economy it is difficult to state positively: they do not seem to be utilized by the plant as a source of energy and in some instances are even poisonous to the plant itself. One of the services they perform for the plant is to aid it in the struggle for existence by being poisonous to animals. The large quantities found in seeds is evidence for the support of this view.

For the most part alkaloids are solid, non-volatile, crystalline bodies, a few being liquid and volatile, that is, arecolin, nicotin, coniin, spartein. The former contain carbon, hydrogen, nitrogen, and oxygen. The three latter liquid alkaloids contain no oxygen and have a marked odor; the solid alkaloids possess no odor. With few exceptions the alkaloids are insoluble (or soluble with great difficulty) in water.

Chemically the alkaloids are divisible into five provisional groups, although it was at one time held that only those bodies belonging to the Pyridin group should be considered as alkaloids. These groups as classed by Brühl are (1) the Pyrrolidin group — containing an alkaloid from the coca leaf, hygrin; (2) the Pyridin group, which contains a large number, pilocarpin, pilocarpidin, arecolin, arecain, coniin, conydrin, piperin, nicotin, atropin, hyoscamin, cocain, pelleterein, spartein, cystisin, and others; (3) Chinolin group — containing cinchonin, quinin, cinchonidin, strychnin, brucin, curarin, and others; (4) Isochinolin group — containing the opium alkaloids, morphin, papaverin, narcotin, codein, thebain, hydrocotarnin, hydrastin, cannabin, berberin, corydalin; (5) alkaloids of undetermined relationship, a few only being of other than chemical interest, ergotinin, colchicin, veratrin, cevadin, jervin, rubijervin, aspidospermin, yohimbin, anhalonin, lupinin, gelsemin, aconitin, pseudoaconitin, japaconitin, delphinin, emetin, etc.

The internal chemical construction of all the alkaloids is extremely complex; for many it is unknown. Most are tertiary bases: a few are similar to the secondary amines in structure. Ammonia bases are also present in many. Many alkaloids acted on by strong alkalies are broken up into two components, a basic body and a nitrogen free, mostly aromatic acid. Most of the alkaloids react similarly to oxidizing agents; nitric acid, chromic acid, potassium ferrocyanide, and potassium permanganate are the most active. The last makes an efficient chemical antidote for many of them. A few alkaloids have been made synthetically. In the making, however, a related base has been necessary.

Physiologically the alkaloids are for the most part very active. Some have very little action, berberin, for example, while aconitin is one of the most toxic of substances. Nearly all of them have a marked affinity for nerve structures, on which a few have markedly poisonous action: some of them attacking the sensory nervous elements more particularly (aconitin, cocain); others exerting their greatest activity on the motor nervous structures, sometimes in the muscle plates (coniin, curarin) causing paralysis; others in the motor cells in the anterior horn cells of the spinal cord (strychnin). Still others exert their influence on the nerve cells of the brain (morphin, hyoscyamin).

History.—The history of the discovery of the alkaloids is about one hundred years old. Derosne of Paris first isolated from opium in 1803 a salt "of opium," as he termed it. This was a mixture of morphin and narcotin, and in 1806 Sertürner, a pharmacist of Hanover, first definitely discovered morphin. It was not until 1817, however, that the discovery was noticed. Following this in rapid succession different alkaloids were isolated,— narcotin and emetin in 1817, veratrin and strychnin in 1818, brucin and piperin in 1819, caffein, cinchonin, and quinin in 1820, and by 1835 at least 30 alkaloids were known. At the present time there are more than 200 known, and new ones are being discovered rapidly; detailed study of more important alkaloids will be found under their respective heads. See ANIMAL ALKALOIDS; PLANTS; POISONS.

Bibliography.—'Introduzione allo Studio degli Alcaloidi,' Icilio Guareschi; translated into German as 'Die Alkaloide,' by Kuntz Krause, is one of the most important of modern works. Also see 'La Constitution Chimique des Alcaloides Végétaux,' by Amé Pictet (2d ed. 1897); 'Die Pflanzen-Alkaloide,' by J. W. Brühl (1900). For studies of location in plants, see Rusby & Jelliffe, 'Morphology and Histology of Plants' (1899, with bibliography).

Al-Khowarazmi, Arabian mathematician of the 9th century. He was the librarian of Al-Mamun at Bagdad, and also worked in the Bagdad Observatory, where he carried on his astronomical and mathematical researches. Among his writings is a geographical treatise, 'Rasm Al-Ard,' giving the latitude and longitude of all places mentioned. He also wrote several mathematical treatises, including one on Hindu arithmetic, and 'Al Jabr wa'l Muqabalah,' discussing the quadratic equation and other algebraic problems; both of these were later translated into Latin, the latter giving algebra its name. See ALGEBRA, HISTORY OF ELEMENTS OF, and ARITHMETIC, HISTORY OF.

Alkmaar, a town of the Netherlands, in the province of North Holland, on the North Holland canal, and 20 m. N.N.W. of Amsterdam. It is regularly built, and its appearance has been much improved by the conversion of its ramparts into public walks. Its finest public buildings are the 15th-century church of St. Lawrence and a richly decorated Gothic town-house. It has manufactures of salt, sail-cloth, etc., and an extensive trade in cattle, corn, butter, and cheese. Among interesting events in its history are its successful defense against the Duke of Alva in 1573, and the invention of dam-

ask-weaving by a citizen, Paschier Lammertyn, in 1595. To the west stood the castle of the counts of Egmont. Pop. (1900) 18,275.

Alkoran. See KORAN.

Al'kyl, the radicals of the alcohols (for example, methyl CH_3; ethyl, C_2H_5; and propyl, C_3H_7) are collectively called alkyls. (See ALCOHOL.) A compound of an alkyl with a halogen is called an alkylogen; and the metallic alcoholates are frequently called alkoxids, since they may be regarded as double oxids of a metal and an alcohol radical.

All Hallows College, Drumcondra, Dublin, Ireland. The foreign missionary college of All Hallows, as its name implies, was instituted for the exclusive object of educating priests for the foreign missions, for the purpose of supplying with missionary priests those parts of the world where the Gospel had never been preached. The missionaries, however, going forth from its halls, were to have as a primary claim on their attention, the spiritual needs, to speak in native parlance, of the "Irish of the dispersion," who, owing chiefly to the effects of bad laws, had begun at that period to emigrate in large numbers from Ireland. All Hallows was founded in the year 1842 by the Rev. John Hand, a native of the diocese of Meath, Ireland, then a young man, but a few years previously ordained at Maynooth. It was formally opened on All Saints' Day of that year with only one student, a very small beginning indeed, but it increased in numbers and resources till it is now probably one of the great foreign missionary colleges in the world. It is at present, and has been for some time past, in charge of the Vincentian Fathers, and was never in a more flourishing condition. It shelters within its walls some 300 students, all destined for the foreign missions. It is pleasantly situated at Drumcondra, one of the suburbs of the metropolis, on a demesne of rich land, obtained for it through the efforts of Daniel O'Connell, at that time Lord Mayor of Dublin. A large number of Catholic priests in the United States received their philosophical and theological training at All Hallows.

REV. JOHN REYNOLDS,
Brooklyn, N. Y.

Al'lactite, a mineral found in Sweden, and crystallizing in small monoclinic prisms or tablets having the composition $7MnO.As_2O_5.4H_2O$. Its hardness is 4.5 and its specific gravity about 3.84. It exhibits double refraction to a marked degree, and varies in color from red to green, according to the direction from which it is viewed. This property has given it its name, "allactite," being derived from a Greek word meaning "to change." The variability in color is due to the varying absorption of the ordinary and extraordinary rays of the incident light. See PHYSICAL CRYSTALLOGRAPHY.

Allah, in Arabic, the name of God, a word compounded of the article *al*, and the word *Elah*, which signifies "the Adored" and "the Adorable," and synonymous with the singular of the Hebrew word *Elohim*. *Allah akbar* (God is great) is a Mohammedan war-cry.

Allahabad, an ancient city of India, capital of a division and district of the same name, as well as of the whole of the northwest provinces, 72 m. W. of Benares. The native town consists largely of mud houses. Its English suburb of Canningtown has much more of a European aspect. Among the remarkable buildings of Allahabad are a large triangular fort, occupying a point of land formed by the junction of the Ganges and Jumna; the Jumna Musjid, or great mosque; the mausoleum of Khosru; All Saints' Church; the Roman Catholic cathedral; the Muir Central College founded in 1874, the chief educational establishment of the northwest provinces; the Mayo Memorial and town hall. Allahabad is one of the chief resorts of Hindu pilgrims, who come partly to visit a sacred cave under the Chali Satum temple (whence it is said there is a subterranean passage to Benares), but chiefly to have their sins washed away by bathing in the waters of the sacred rivers of Ganges and Jumna at their junction, where believers see a third river, the Saraswati (which is in reality lost in the sands at a distance of 400 miles from Allahabad), mingle its current with those of the other two. A great fair held on 14 December is much attended by pilgrims. There are few manufactures. Allahabad forms a junction in the railway system between Bengal and Central India, and its trade is rapidly increasing. In the mutiny of 1857 it was the scene of a serious outbreak and massacre. Pop. (1901) 175,750. The division of Allahabad contains the districts of Cawnpur, Futtehpur, Hamirpur, Banda, Jhansi, Jalaun, Lalitpur, and Allahabad. The agriculture of the division is greatly promoted by a canal 310 miles long, connecting the Ganges and the Jumna. About five sixths of the surface is under cultivation, the principal crops being rice, pulse, wheat, tobacco, etc. Pop. (1901) 1,548,737.

Allan, Sir Hugh, founder of the Allan line of steamships: b. Scotland, 29 Sept. 1810; d. Edinburgh, 8 Dec. 1882. A clerk with limited education, he emigrated to Canada in 1824, was clerk in Montreal stores, became captain in the rebellion of 1837, and in 1838 succeeded his late employer as a partner in the shipping and shipbuilding business. In 1853 his firm began building iron screw steamships, and their first vessel, the Canadian, made its first voyage in 1855, two more being used as transports in the Crimean war. The Allan Line, after many disasters, gained a permanent footing, and has been a large element in developing Canadian prosperity. Sir Hugh was one of the projectors of the Canadian Pacific Railway, and prominent in the political investigations to which it led. He was a director in banking, telegraph, gold mining, and other large business enterprises, and was knighted in 1871.

Allan, Sir William, a distinguished Scottish artist: b. 1782; d. 1850. He was a fellow student with Wilkie in Edinburgh, afterward a student of the Royal Academy, London; then went to Saint Petersburg and remained for 10 years in the Russian dominions. In 1814 he returned to Scotland and publicly exhibited his pictures, one of which ('Circassian Captives') made his reputation. He now turned his attention to historical painting and produced scenes from Scottish history and battle scenes; among them two pictures of the battle of Waterloo, one from the British, the other from the French position, and delineating the actual scene and the incidents therein taking place at the moment chosen for the representation. One of these Waterloo pictures was purchased by the Duke of Wellington. He traveled ex-

tensively, visiting Italy, Greece, Asia Minor, Spain, and Barbary. In 1835 he became R.A., in 1838 president of the Scottish Academy; in 1842 he was knighted.

Allan, William, American military writer: b. Virginia, 1837; d. 1880. He was a lieutenant-colonel in the Confederate army during the Civil War. His works are: 'Jackson's Valley Campaign' (1862); 'The Battle-Fields of Virginia' (1867); and 'The Army of Northern Virginia.'

Al'lanite, a mineral, isomorphous with epidote, and containing rare metals of the Cerium and Yttrium groups. It is variable in composition, but is essentially a silicate of these metals, combined with aluminum, iron, and calcium. It occurs in Norway and Finland, and in the United States in Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Virginia, and North Carolina; also in Canada. It was named for Thomas Allan, of Edinburgh, who described it in 1808. (Also called orthite.)

Allan'toin, a-lan'tō-in, a substance found in the allantoic fluid of the cow, in the urine of sucking calves, in the leaf buds of the maple, and in the bark of the horse-chestnut tree. It is readily soluble in alcohol and crystallizes in monoclinic prisms having the formula $C_4H_6N_4O_3$. It may be formed by treating uric acid with boiling water and PbO_2. Compounds of allantoin with several of the metals are known.

Allantois, a structure appearing during the early development of vertebrate animals — reptiles, birds, and mammalia. It is largely made up of blood-vessels, and, especially in birds, attains a large size. It forms the inner lining to the shell, and may thus be viewed as the surface by means of which the respiration of the embryo is carried on. In mammalia the allantois is not so largely developed as in birds, and it enters largely into the formation of the placenta.

Al'legan, Mich., town and county-seat of Allegan County, 33 m. S. of Grand Rapids. It is situated on the Kalamazoo River and on the Cincinnati N., Lake Shore & M. S., and the Pére M. R.R.'s. It is in the midst of a fertile region, and a large dam on the river a few miles above the village affords valuable water power. Among its industries are mills of various kinds, carriage works, furniture factories, etc. It contains a public library, two banks, court house, city hall, and public schools. First settled in 1834. Pop. (1905) 3,941.

Allegation is the assertion, declaration, or statement by a party of what he can prove. Under the reformed method of procedure adopted in nearly if not all of the States of the Union, the general rule that the allegations in the pleadings and the proof must correspond has been greatly relaxed. Under our present system a failure to prove an immaterial averment cannot in general be a material variance at the trial, and will be disregarded. If the substance of the issue be proved it is sufficient. If a contract, for instance, agree in substance and legal effect with that stated in the complaint, the variance will be disregarded.

Alleghanies, a name sometimes used to designate the entire Appalachian mountain system, but more properly applied to the western range of this system in Pennsylvania, Maryland, Virginia, and West Virginia. They begin near the New York and Pennsylvania border — the Catskills forming a northern outline — and extend in a southwesterly direction into West Virginia, where the line of elevations is continued by other ranges across Tennessee. In the northern part the mountains have an elevation of about 2,000 feet (over 4,000 feet in the Catskills), but they gradually increase in altitude southward until in Virginia they rise to 4,500 feet above the sea. Throughout their extent they present a remarkably even crest-line with few gaps and isolated peaks. On the eastern side the slope is abrupt to the bottom of the longitudinal valley from 50 to 100 miles wide, which is limited on the east by the parallel range of the Blue Ridge; on the west the elevations fall off more gradually. The range forms the water-parting between the streams draining into the Atlantic Ocean and the Gulf of Mexico. The former receives the drainage from the eastern slope principally through the Delaware, Potomac, and James Rivers, while the Ohio River collects most of the waters on the western side. The range has been formed by uplift and folding of sedimentary strata, the abrupt edges of which are turned toward the east. Limestone, sandstones, and conglomerates are the predominant formations and range from the Cambrian to the Carboniferous systems. Immense coal-seams occur in the higher part of the series, forming the basis of a great mining industry. See APPALACHIANS.

Allegheny, Pa., a large manufacturing and residential city opposite Pittsburg on the right or north bank of the Allegheny river and stretching down along the Ohio river, here formed by the confluence of the Allegheny river with the Monongahela; connected with Pittsburg by three wooden and five modern steel bridges crossed by numerous electric railways. Is the home city for a large proportion of the business men of Pittsburg. Although having separate municipal governments Pittsburg and Allegheny form practically one great city of over half a million people; their business interests being based upon the same natural advantages and the same railroad and river transportation facilities being common to both.

Interior.— Allegheny has a river frontage of six and one-half miles and an area of over 5,000 acres. Originally laid out upon a small plateau slightly elevated above the river, it has gradually spread out over the surrounding hills which rise seven hundred feet above the river or thirteen hundred feet above sea level. The hill districts now made accessible by electric railways form a desirable home section. The city owns its own electric lighting plant and pumps its water from the Allegheny river at Montrose nine miles above the city. Has 180 miles of streets, over 100 miles paved, over 80 miles of sewers and 140 miles of water mains. There are two public parks, Allegheny Park, of 100 acres, in the centre of the city, and Riverview Park in the northern district.

The most noteworthy monuments are the Anderson monument at the corner of Federal and Ohio streets, the two most important thoroughfares, the Humboldt, Armstrong, Wash-

ington and Hampton battery in the Allegheny parks and the Soldier's on a height to the west.

Education.—An efficient public school system is maintained at a cost of about $400,000 a year. There are 27 public school buildings valued at over $2,000,000 and attended by 30,000 pupils.

Is the seat of the Western (Presbyterian), United Presbyterian, and the Reformed Presbyterian Theological Seminaries, and the Western University. The latter was founded in 1819 and is now attended by over 700 students. Under its control is the famous Allegheny Observatory located on a height in Riverview Park. In connection with the public schools a public library of some 20,000 volumes is maintained, located in the High School Building. The Carnegie Free Library of nearly 60,000 volumes, the first of the large number of libraries founded by the munificence of Andrew Carnegie, is located on one of the corners of the public square and is the most conspicuous building in the city.

Religion.— There are 111 churches, the most prominent edifices being St. Peter's (R. C.), Trinity (Ev. Luth.), North Avenue (M. E.), Emanuel (Prot. Epis.), and Sandusky Street (Baptist).

Benevolent Institutions.—Three modern well-equipped hospitals are maintained, viz., Allegheny General, Presbyterian, and Saint John's (Lutheran). Of orphan asylums and other benevolent institutions the most important are The Home of the Friendless, The Orphan Home for Colored Children, The Orphans' Home on Ridge Avenue, and the Saint Joseph's (R. C.) Orphan Asylum. Also the seat of the Western Penitentiary.

Trade and Manufacturing.— The system of slack water navigation now under construction by the United States government on both the Allegheny and Ohio rivers make this an important shipping centre especially for coal and other bulky products. The heaviest manufactures are those developed by Pennsylvania's coal and iron, foundries and blast furnaces, rolling mills, locomotive and car works, machinery, stoves and furnaces, plumbers' goods; other products are glass, white lead, and colors. There are also large flour mills and four large pickling and preserving establishments. At one time the city was the centre of the tanning industry of the United States and still has many large tanneries in operation. In 1900 there were reported 893 manufacturing establishments, with 20,804 employes and an output valued at $54,136,967, paying $10,352,502 for wages and using $50,122,503 capital.

Finances.— The assessed valuation in 1905 was over $95,000,000. The city's expenditures are over $2,500,000 a year, of which $400,000 goes for schools and $150,000 each for the police and fire departments. There are ten banks with an aggregate capital and surplus of $7,000,000.

Government.— The executive power is vested in a mayor elected for a three year term. The mayor appoints all the minor city officials and employes. The legislative power is vested in the city council of two chambers.

History and Population.— The settlement was laid out in 1788 and incorporated as a borough in 1828. The first settlers consisted largely of Scotch-Irish, later reinforced by a large influx of German immigrants. In 1840 it had a population of 10,089 and was granted a city charter. Its population according to the census of 1900 was 129,896 and its estimated population now (1906) is 145,000. Its greatest disasters were in 1874: a fire on July 4th wholly or partially destroyed 199 buildings, and three weeks later a heavy local flood swept away much property and cost 124 lives. EDWARD E. EGGERS,

Librarian Carnegie Free Library, Allegheny.

Allegheny College, a co-educational (Methodist Episcopal) institution in Meadville, Pa.; organized in 1815 reported at the end of 1905: Professors, 16; students, 290; volumes in the library, 20,000; grounds and buildings valued at $200,000; productive funds, $450,000; income, $42,500; graduates, 1,386.

Allegheny River, a river of Pennsylvania and New York; a headstream of the Ohio. It rises in Potter County, Pa., and joins the Monongahela at Pittsburg. Among its tributaries are French Creek and Clarion and Conemaugh rivers. Its length is about 400 miles, and it is navigable for about 150 miles above Pittsburg.

Allegiance is the obligation of fidelity and obedience which an individual owes to the government under which he lives, or to his sovereign in return for the protection he receives. It may be an absolute and permanent obligation, or it may be qualified and temporary one. The citizen or subject owes an absolute and permanent allegiance to his government or sovereign, or at least until, by some open and distinct act, he renounces it and becomes a citizen or subject of another government or another sovereign. While domiciled in this country the alien owes a temporary and local allegiance which continues during the period of his residence.

Publicists and statesmen everywhere recognize this obligation of temporary allegiance by an alien resident in a friendly country. In the case of Thrasher, a citizen of the United States resident in Cuba, who complained of injuries suffered from the government of that island, Mr. Webster, then secretary of state, made in 1851 a report to the President in answer to a resolution of the House of Representatives, in which he said: "Every foreigner born, residing in a country, owes to that country allegiance and obedience to its laws so long as he remains in it, as a duty upon him by the mere fact of his residence and that temporary protection which he enjoys, and is as much bound to obey its laws as native subjects or citizens. This is the universal understanding in all civilized states, and nowhere a more established doctrine than in this country."

Acquired allegiance is that kind of allegiance which binds a citizen who was born an alien, but has been naturalized.

Local allegiance is that which is due from an alien while resident in a country, in return for the protection afforded by the government.

Natural allegiance is that which results from the birth of a person within the territory and under the obedience of the government. It was at one time a fundamental principle of the common law of England that natural allegiance was perpetual and could not be renounced without consent of the sovereign. The same doctrine was maintained in the United States for some years. This principle has, however, been re-

pudiated by statute in both countries. The act of Congress enacted 27 July 1868 declared that «the right of expatriation is a natural and inherent right of all people, indispensable to the enjoyment of the right of life, liberty, and the pursuit of happiness. The British Naturalization Act of 1870 has practically the same provisions. The fourteenth amendment to the Constitution of the United States provides that «all persons born or naturalized in the United States and subject to the jurisdiction thereof are citizens of the United States and of the State wherein they reside.» The consequence of this amendment is that the individual owes allegiance to the State in which he resides, and to the Federal government, his duty to the latter being paramount.

Allegory (from Greek *allo*, something else, and *agoreuein*, to speak), a figurative representation, in which the signs (words or forms) signify something besides their literal or direct meaning, each meaning being complete in itself. In rhetoric, allegory is often but a continued simile. Parables and fables are a species of allegory; for example, the beautiful parable in one of the tales in the 'Arabian Nights,' in which the three religions, the Mohammedan, Jewish, and Christian, are compared to three similar rings, bequeathed to three brothers by their father. Sometimes whole works are allegorical, as 'Reynard the Fox,' Spenser's 'Faerie Queene,' and Bunyan's 'Pilgrim's Progress.' When an allegory is thus continued through long works it is indispensable to its success that not only the allegorical meaning should be appropriate, but that the story should have an interest of its own in the direct meaning apart from the allegorical signification. There was a time when every poem was taken as an allegory; even such works as those of Ariosto and Tasso were tortured from their true meaning and made to pass for allegorical pictures. No poet has made use of allegory in a more powerful and truly poetical manner than the great Dante. Allegory is often made use of in painting and sculpture as well as in literature.

Allegri, Gregorio, an Italian composer and a singer in the papal chapel, considered one of the most excellent composers of his time: b. Rome about 1580 (according to others 1590); d. there 1652. His «Miserere» has particularly distinguished him. It is even now regularly sung during Passion Week in the Sistine Chapel at Rome. Its subject is the fifty-seventh psalm (which in the Latin version begins with the word *Miserere*), and is composed for two choruses in five- and in four-part harmony. This composition was once esteemed so holy that whoever ventured to transcribe it was liable to excommunication. In 1770 Mozart, then only 14 years of age, disregarded this prohibition, and after two hearings made a correct copy of the original.

Allegro, an Italian word signifying gay, and used in music to express a more or less quick rate of movement. The degrees of quickness are indicated by additional qualifying words or by derivatives of the word *allegro*. Thus *allegretto* or *poco allegro* means rather lively; *allegro moderato, commodo, giusto*, moderately quick; *allegro maestoso,* quick but with dignity; *allegro assai* and *allegro molto*, very quick; *allegro con brio* or *con fuoco*, with fire and energy; *allegrissimo*, with the utmost rapidity. *Piu allegro* is a direction to play or sing a little quicker. *Presto* indicates a still quicker rate than *allegro*, but there is usually also this difference between the *presto* and *allegro* movements, that the former demands nothing more than rapid execution, while the latter requires to be performed with expression as well as quickness. The first movement of a symphony and other similar compositions is called the *allegro*. See MUSIC.

Alleine, Joseph, English nonconformist clergyman: b. Devizes, 1634; d. Taunton, 17 Nov. 1668. Educated at Oxford, he became assistant at St. Mary Magdalene's Church, Taunton, in 1655, but was ejected for nonconformity in 1662. He was the author of 'An Alarm to the Unconverted.'

Allemontite, a tin-white, metallic mineral, regarded as a native alloy of arsenic and antimony, $SbAs_3$. It usually occurs in fine-granular or mammillary forms. Its hardness is 3.5 and specific gravity about 6.20. It is found at Allemont in France, also in Bohemia and Germany.

Allen, Alexander Viets Griswold, Protestant theologian: b. Otis, Mass., 4 May 1841. Graduated Kenyon College, O., 1862, Andover Theological Seminary, 1865; rector St. John's Episcopal Church, Lawrence, Mass., 1865–7; professor of church history, Episcopal Theological School, Cambridge, since 1867. A prominent leader in modern religious thought; he has written 'Continuity of Christian Thought' (1884); 'Life of Jonathan Edwards' (1889); 'Religious Progress' (1893); 'Christian Institutions' (1897); 'Life and Letters of Phillips Brooks' (1900).

Allen, Alfred, author and playwright: b. Alfred, N. Y., 8 April 1866. He graduated at Alfred University, studied at the Johns Hopkins and Columbia universities and the American Academy of Dramatic Arts in which last he is now a professor. His plays are 'Jack the Giant Killer'; 'A Burglar Honeymoon'; 'Playmates'; and 'Head of the House'; all have been produced on the stage. Novels: 'The Heart of Don Vega'; 'Judge Lynch'; 'The Cup of Victory' (with Richard Hovey).

Allen, Charles Grant Blairfindie. See ALLEN, GRANT.

Allen, Charles Herbert, American diplomatist: b. Lowell, Mass., 15 April 1848. He graduated at Amherst 1869; associated with his father in the lumber business in Lowell; served in both branches of the State legislature, and in Congress in 1885–9; was defeated as Republican candidate for governor of Massachusetts, 1891; and succeeded Theodore Roosevelt as assistant secretary of the navy in May 1898. On the passage by Congress of the Porto Rico tariff and civil government bill, in April 1900, the President appointed him the first civil governor of Porto Rico; he resigned July 1901.

Allen, David Oliver, missionary: b. Barre, Mass., 1800; d. Lowell, Mass., 17 July 1863. He was graduated at Amherst College in 1823;

and became a missionary in western India 1827–53. He established schools in the province of Bombay, wrote tracts in Mahratta, and edited a new translation of the Bible in that language. He also wrote a 'History of India, Ancient and Modern' (1856).

Allen, Ebenezer, American soldier: b. Northampton, Mass., 17 Oct. 1743; d. 26 March 1806. He emigrated to Vermont in 1771, and was made a lieutenant in Col. Seth Warner's regiment of «Green Mountain Boys.» In 1776 he was a delegate to the conventions in the New Hampshire grants, and in 1777 to those which declared the State independent and framed its Constitution. In July of that year he was made captain in Herrick's battalion of «Rangers,» and took an active part in the battle of Bennington; in September he captured Mount Defiance; and he took fifty prisoners among the troops retreating from Ticonderoga. He afterward became major and continued to win distinction during the war. He lived at Burlington in his later years.

Allen, Edward Patrick, an American Roman Catholic clergyman: b. Lowell, Mass., 17 March 1853. He worked in the Lowell mills as a boy, acquiring his early education at an evening school and from local priests; graduated at Mount St. Mary's College, Emmitsburg, Md., in 1878; took a course in theology; was ordained a priest in 1881; was president of Mount St. Mary's College in 1884–97; and on 16 May 1897 was consecrated fifth bishop of Mobile, Ala.

Allen, Elisha Hunt, American legislator and diplomat: b. New Salem, Mass., 28 Jan. 1804; d. 1 Jan. 1883. Graduating at Williams College, 1823, he became a lawyer at Brattleboro, Vt., but soon removed to Bangor, Me., and was a member of the Maine legislature 1834–41, and speaker in 1838. He was elected representative to Congress in 1841. Removing to Boston in 1847, he was elected to the Massachusetts legislature in 1849. Appointed consul at Honolulu in 1852, he held that post till 1856, and thence till 1876 was chancellor, minister of finance, and chief justice of the Hawaiian kingdom. Several times during that period and from 1876 onward he was its minister to the United States and died in Washington, dean of the diplomatic corps.

Allen, Elizabeth Akers (Chase), American poet: b. Strong, Me., 9 Oct. 1832. She was married in 1860 to Paul Akers, the sculptor, who died in 1861; and in 1865 to E. M. Allen of New York. Her first volume, 'Forest Buds,' appeared under the pen name of «Florence Percy» (1855). Other works: 'The Silver Bridge and Other Poems' (1866); a volume of 'Poems' (1866), which contains 'Rock Me to Sleep, Mother' (her authorship of this popular ballad, once disputed, is proved in the New York *Times*, 27 May 1867); 'The High Top Sweeting and other Poems' (1891), 'Sunset-Song' (1902).

Allen, Ethan, American soldier: b. Litchfield, Conn., 10 Jan. 1737; d. 13 Feb. 1789. About 1769 he removed to Bennington, Vt. The Vermont territory had been given by the Crown to both New Hampshire and New York under conflicting grants; and when the dispute was settled (1764) in favor of New York, Gov. Wentworth of New Hampshire had already granted 128 townships, and continued to grant others up to the Revolution. New York at once proceeded to re-grant the same territory, but the indignant settlers drove out the surveyors, applying the «beech seal» (fresh-cut rods) to enforce their withdrawal. The English government ordered the *status quo* to be respected by New York, and further disorders averted by granting only ungranted lands; the New York authorities continued to send surveyors, their grantees persisted in attempting to take possession of their lands, and the New Hampshire grantees continued to eject both deputy sheriffs and claimants by armed force and to chastise them besides. Allen at once took part in the dispute and soon became a leader: an athletic and adventurous giant, he was now in his element. In 1770 he was appointed agent for the settlers at Albany, where they were to plead their rights; the decision went against them, and a fresh attempt being made to enforce New York rights, the settlers raised a regiment for defense, called «Green Mountain Boys,» of which Allen was made colonel. Tryon of New York, historically more renowned for vanity and bad temper than ability or success, proclaimed him an outlaw and offered £150 for his capture; but under Allen, Seth Warner, and other able partisan chiefs the settlers held New York at bay. Allen in 1774 answered publications in defense of the New York claims by a tract defending the Vermonters, reprinted in 1779. When the Revolution broke out Congress ordered Arnold to raise troops and seize the British fortresses on the New York border; but the Vermonters forestalled them by collecting a force of «Green Mountain Boys» at Castleton, Vt., under Allen's command, which on 10 May 1775, captured Ticonderoga and its garrison without a combat, and shortly after Crown Point and Skenesborough (Whitehall), giving them a mass of stores and the command of Lake Champlain. This action moved Congress to grant them the same pay as Continental soldiers, and to recommend the New York Assembly to employ them in the army under their own officers. Allen and Warner journeyed thither and asked admittance to the session; and after some grumbling over receiving proclaimed felons a heavy majority voted to admit Allen, and later to raise a regiment of Green Mountain Boys. Allen wrote a letter of thanks, and proposed an invasion of Canada, which was rejected. He then joined Schuyler's army as a volunteer, was sent on secret missions to Canada, meeting on the last one Col. John Brown, who agreed to join him in an invasion of Canada. Fort Chambly was captured; but Brown left Allen in the lurch at the attack on Montreal, and Allen was taken prisoner 25 September and sent to England. He was chained and treated with great severity, but after some months was sent to Halifax, N. S., and exchanged 6 May 1778. On returning to Vermont he was appointed commander of the militia, and Congress made him lieutenant-colonel in the regular army. The old land-grant feud still raged, and in the attempted British intrigue (1780–3) to have Vermont annex itself to Canada as a protection against New York, Allen paralyzed British military action by professing to consider a bribe for favorable action; later he was charged with treason, but the charge was

not sustained. He settled in Bennington and finally in Burlington, where he died. He was a member of the legislature; and after the war was a delegate to Congress, where he worked for the admission of Vermont as a State, which it had been by self-proclamation since 1777. It was not till 1789, however, that New York waived its claims, and Allen did not live to see the result. He wrote the story of his captivity (1779); and 'Reason the Only Oracle of Man' (1784), being a deist of the Paine stripe. (See Sparks' 'Life,' and Henry Hall's 'Ethan Allen,' 1892.)

Allen, Frederick De Forest, classical scholar: b. Oberlin, Ohio, 1844; d. Cambridge, Mass., 4 Aug. 1897. He graduated at Oberlin College 1863, and studied at Leipsic. From 1866 to 1880 he held professorships in the universities of Tennessee, Cincinnati, and Yale. In 1880 he accepted the chair of classical philology at Harvard, holding it until his death. He published an edition of Euripides' 'Medea' (1876), 'Remnants of Early Latin' (1880), a revision of Hadley's 'Greek Grammar' (1884), and 'Greek Versification in Inscriptions' (1880); besides contributing many papers to classical journals and editing numerous classics.

Allen, Fred Hovey, author and Congregational clergyman: b. Lyme, N. H., 1 Oct. 1845. He graduated at Hartford Theological Seminary and studied abroad. Later he became pastor at Boston and Abingdon, Mass., and editor of the Suffolk County *Journal*, Boston, and a lecturer on art. He has published: 'Modern German Masters' (1885); 'Recent German Art' (1885); 'Great Cathedrals of the World' (1886); 'Popular History of the Reformation' (1887); and edited numerous art works.

Allen, George William, Canadian statesman: b. Toronto 1822. Called to the bar in 1846 he became senator in 1867. For many years he was chairman of the Committee on Banking and Commerce. In 1891 he became member of the Queen's privy council for Canada. He presented the city of Toronto with the ground on which is built the Canadian Institute. He was for a long time chancellor of the University of Toronto.

Allen, Grant (Charles Grant Blairfindie Allen), essayist, novelist, naturalist: b. Kingston, Canada, 24 Feb. 1848; d. London, 25 Oct. 1899. He graduated at Oxford in 1871, and for a time was professor of logic and philosophy in Jamaica, but spent the greater part of his life in England. Widely known as a scientist in several departments, he aimed to popularize science, and his brilliant style contributed greatly to his success in this respect. His score or so of novels and works of light fiction attained great popularity, but though entertaining have only an ephemeral value. His outspoken agnosticism is reflected in many of his writings. In science his chief titles are, 'Physiological Æsthetics' (1877); 'The Color Sense' (1879); 'Evolutionist at Large' (1881); 'Flowers and Their Pedigrees' (1883); 'Charles Darwin' (1885); 'Force and Energy' (1888); 'Story of the Plants' (1896); 'Evolution of the Idea of God' (1897). In fiction the following were most widely read, 'This Mortal Coil' (1888); 'The Great Taboo' (1890); 'The Duchess of Powysland' (1891); 'The Woman Who Did' (1895); 'The British Barbarians' (1895); 'Under Sealed Orders' (1896).

Allen, Harrison, anatomist: b. Philadelphia, 17 April 1844; d. there, 14 Nov. 1897. He graduated M.D. at the University of Pennsylvania 1861; was assistant surgeon in the United States army 1862–5; professor of comparative anatomy and medical zoology in the University of Pennsylvania 1865–78, and of physiology 1878–95. He was the author of numerous articles and books on the subjects connected with his professorship, and of 'Studies in the Facial Region' (1874); 'Analysis of the Life Form in Art' (1875); 'System of Human Anatomy' (1880).

Allen, Henry, religious enthusiast: b. Newport, R. I., 14 June 1748; d. Northampton, N. H., 2 Feb. 1784. He was founder of the sect known as «Allenites» and made numerous converts in Nova Scotia. He asserted that Adam and Eve before the fall had not corporeal bodies, that the Bible is to be interpreted wholly in a mystic or spiritual sense, and denied the doctrine of the resurrection of the body. He was an eloquent preacher and published some sermons and hymns.

Allen, Henry Watkins, American soldier and public officer: b. Prince Edward County, Va., 29 April 1820; d. 22 April 1866. He removed in early youth to Missouri, where he was sent to Marion College; he subsequently became a teacher in Grand Gulf, Miss., studied law and entered practice there. He raised a company for Houston's Texas war against Mexico; and after the war was over resumed practice, and was sent to the legislature in 1846. Settling in Baton Rouge, he was elected to the Louisiana legislature in 1853. In 1859 he went to Italy, to share her struggle for independence against Austria; but arriving after it was over, made a tour of Europe, which he described in 'Travels of a Sugar Planter.' He was elected to the legislature in his absence. He was one of the Southern Whigs who joined the Democrats after the party break-up caused by the Kansas-Nebraska bill. At the opening of the War he was commissioned by the Confederacy lieutenant-colonel; later colonel, and military governor at Jackson. He was wounded at Shiloh; constructed fortifications at Vicksburg; was disabled at Baton Rouge; made brigadier-general September 1864; and shortly after elected governor of Louisiana. He was a vigorous and efficient magistrate, with almost dictatorial powers. After the War he migrated to Mexico and started the (English) Mexico *Times* in the city of Mexico, where he died.

Allen, Horace N., American minister: b. Delaware, Ohio, 23 April 1858. He graduated at Ohio Wesleyan University, and after a medical course went to China as Presbyterian missionary. Going to Korea in 1884 he was in Seoul at the time of the *coup d'état* of that year and saved the life of a prince related to the queen; he was thereupon made court physician and allowed to establish a hospital under government orders. He came to Washington in 1887 with the first Korean legation, and returned in 1890 as United States secretary of legation: won great confidence for sagacity and acquaintance with Korea and in 1897 was made United States minister

there. He has written ‹ Korean Tales ›; a chronological index of Korea's foreign relations; and many papers for the ‹ Korean Repository › and the ‹ Transactions of the Foreign Society of Korea.›

Allen, Horatio, American engineer: b. Schenectady, N. Y., 1802: d. 1889. Graduating at Columbia University in 1823, in 1826 he was resident engineer on the summit level of the Delaware & Hudson Canal, and was sent to England in 1828 to buy locomotives for its proposed railway. In 1829 he made the first locomotive trip in America at Honesdale, Pa., with the ‹ Stourbridge Lion.› He was chief engineer, 1829–34, of the South Carolina Railway, then the longest line in the world; and in 1838–42 was chief assistant engineer of the Croton Aqueduct. He was chief engineer and afterward president of the Erie Railway, consulting engineer of the Panama Railway and the Brooklyn Bridge; president of the American Society of Civil Engineers 1872–3. He invented the swivel cartruck.

Allen, Ira, younger brother of Ethan (q.v.) and a « Green Mountain Boy »: b. Cornwall, Conn., 21 April 1751; d. 7 Jan. 1814. He went to Vermont in 1772 and was an active supporter of Ethan in the « beech seal » proceedings. He was a member of the Vermont legislature 1776–7, and of the Vermont Constitutional Convention 1778; was its first secretary of state, then its treasurer, and surveyor-general. He was in the battle of Bennington, 1777. In 1780–1 he was a Vermont commissioner to Congress to contest the New York land claim. In 1789 he aided in organizing the University of Vermont; and in 1792 was a delegate to the convention that ratified the United States Constitution after Vermont's admission as a State. In 1795, as senior major-general of militia, he went to France and bought arms to be sold to the State; but in returning was captured by an English cruiser, taken to England, and charged with supplying the Irish rebels with arms, and only won his suit after eight years. Imprisoned in France in 1798 he returned to the United States in 1801. He wrote ‹ The Natural and Political History of Vermont › (London 1798); ‹ Statements Appended to the Olive Branch › (1807).

Allen, James Lane, American novelist: b. near Lexington, Ky., 1849. He was educated at Transylvania University in his native State and was successively an instructor in Kentucky University and Bethany College, West Virginia. In 1886 he removed to New York city and has since devoted himself entirely to literary pursuits. In his short stories and novels he has usually employed a Kentucky background, and his finished literary style, though somewhat too highly elaborated for the taste of the average reader, has been much admired by the more critical. His prose is characterized by a markedly poetic cast, and his realism is of that profounder kind which concerns itself with essential truths rather than with photographic fidelity to local types. His published books comprise: ‹ Flute and Violin › (1891); ‹ The Blue Grass Region and Other Sketches › (1892); ‹ John Gray, a Novel › (1893); ‹ A Kentucky Cardinal › (1894); ‹ Aftermath › (1895); ‹ A Summer in Arcady › (1896); ‹ The Choir Invisible › an expanded version of ‹ John Gray › (1897); ‹ The Reign of Law › (1900).

Allen, Jerome, American educator: b. Westminster West, Vt., 1830; d. 1894. He graduated at Amherst 1851; was professor and principal of several Western institutions thence till 1885; professor of pedagogy at the University of New York 1887–93. He was the chief agency in founding the New York School of Pedagogy and became its dean in 1889. He wrote a ‹ Handbook of Experimental Chemistry ›; ‹ Methods for Teachers in Grammar ›; ‹ Mind Studies for Young Teachers ›; and ‹ Temperament in Education.›

Allen, Joel Asaph, naturalist: b. Springfield, Mass., 19 July 1838. He studied under Agassiz at Harvard; took part in scientific expeditions to Brazil, the Rocky Mountains, and Florida 1865–9; was chief of the scientific party accompanying the Northern Pacific railroad survey 1873; and curator of vertebrate zoology in the American Museum of Natural History, New York, since 1885. He is author of ‹ Monographs of North American Rodentia › (with E. Coues, 1877); ‹ History of North American Pinnipedes › (1880); editor of ‹ Bulletin of Nuttall Ornithological Club › (1876–83), and of its successor, ‹ The Auk › (1884–1901); and has written hundreds of minor articles on ornithology and mammalogy.

Allen, Sir John Campbell, Canadian jurist: b. Kingslear, N. B., October 1817; d. Fredericton, N. B., 27 Sept. 1898. He was member of the New Brunswick House of Assembly 1856–65; solicitor-general 1856–7; speaker 1863–5; attorney-general 1865. He opposed the confederation of the Maritime Provinces and Canada. He was chief justice of the supreme court 1875–96, and was knighted by the queen 1889. His ‹ Law Reports › (6 vols.) and rules of the supreme court and acts of assembly relating to the practice of the courts are ranked highly.

Allen, John Romilly, English civil engineer and archæologist: b. London, 9 June 1847. Educated at Rugby and King's College, London, he became resident engineer on Baron de Reuter's Persian railways, and on the construction of the docks at Leith and at Boston, Lincolnshire. Has lectured on archæology at Edinburgh University College, London. His published books are: ‹ Design and Construction of Dock Walls › (1876); ‹ Christian Symbolism in Great Britain › (1887); ‹ Monumental History of the Early British Church › (1889); ‹ Early Christian Monuments of Scotland › (1903).

Allen, Joseph Henry, Unitarian clergyman and author: b. Northborough, Mass., 21 Aug. 1821; d. Cambridge, Mass., 20 March 1898. He graduated at Harvard 1840, and at its divinity school 1843, and filled pastorates at Northborough, Roxbury, Mass., Washington, D. C., Bangor, Me., and other places till 1878. For twelve years he was editor of the ‹ Christian Examiner.› He was also lecturer on ecclesiastical history at Harvard 1878–82, editor of the ‹ Unitarian Review › 1887–98, and a prolific writer on religious and philosophical subjects. His chief works are: ‹ Ten Discourses on Orthodoxy › (1849); ‹ Hebrew Men and Times › (1861); ‹ Christian History in its Three Great Periods › (3 vols. 1880–2); ‹ Positive Religion › (1892); ‹ Unitarianism Since the Reformation › (1894); translations of Renan's ‹ Anti-

Christ,' 'Origins of Christianity,' and 'History of the People of Israel.' A Latin grammar and other schoolbooks, prepared in collaboration with Prof. J. B. Greenough, are extensively used.

Allen, Karl Ferdinand, Danish historian: b. Copenhagen, 23 April 1811; d. there, 27 Dec. 1871. He became professor of history and northern archæology at the University of Copenhagen in 1862. His principal works are: 'Handbook of the History of the Fatherland' (1840), very democratic in tone, and 'History of the Three Northern Kingdoms' (1864-72).

Allen, Richard, preacher: b. 1760; d. Philadelphia, 26 March 1831. He organized the first church for colored people in the United States and was elected first bishop of the African Methodist Episcopal Church, 1816.

Allen, Robert, American soldier: b. Ohio about 1815; d. Geneva, Switzerland, 1886. Graduating at West Point in 1836, he was second lieutenant in the Seminole war, assistant quartermaster in the Mexican war, brevetted major for conduct at Cerro Gordo, and was in the battles that led to the capture of the City of Mexico. Appointed chief quartermaster of the Pacific division, he was transferred to Missouri at the outbreak of the Civil War, with headquarters in St. Louis, in charge of supplies and transportation for armies in the Mississippi Valley. He was made colonel in 1862, brigadier-general of volunteers 1863, brevet brigadier-general in the regular army 1864, brevet major-general 1865. From November 1863 to 1866 he was chief quartermaster of the Mississippi Valley with headquarters at Louisville, outfitted Sherman's march across country to Chattanooga, and the Kentucky, Virginia, and North Carolina expeditions. After serving a second time as chief quartermaster of the Pacific division he was retired in 1878.

Allen, Thomas, landscape and animal painter: b. St. Louis, 19 Oct. 1849. He studied at Washington University, graduated at Royal Academy of Düsseldorf, and studied in France three years. Has frequently exhibited at the Paris salons and was a judge of awards at the World's Fair, Chicago, 1893. His studio is in Boston, Mass.

Allen, Viola, American actress: b. 1867; made her début at the age of 15 at Madison Square Theatre, N. Y., in 'Esmeralda.' She has played leading classical, Shakespearean, and comedy roles with Lawrence Barrett, Salvini, Joseph Jefferson, and W. J. Florence. Between 1893–1900 created and played parts in 'Sowing the Wind,' 'The Masqueraders,' 'Under the Red Robe,' and starred in Hall Caine's 'Christian' and F. M. Crawford's 'In the Palace of the King.'

Allen, Walter, American author and journalist: b. Boston, Mass., 21 March 1840. He graduated at Yale in 1863; served in the paymaster's department of the navy, 1864–5; has been connected with leading newspapers in Portland, Me., Cincinnati, Boston, and New York, and contributed to the periodicals: and was appointed by President Hayes to investigate the condition of the Ponca Indians. He was assistant editor of Webster's International Dictionary and author of 'Governor Chamberlain's Administration in South Carolina' and 'Life of Gen. U. S. Grant.'

Allen, William, Cardinal, English ecclesiastic: b. 1532 in Lancashire, studied at Oxford and was Fellow of Oriel College. Owing to the persecution of Catholics under Queen Elizabeth he left England, and in 1568 he, with the assistance of Dr. Vendeville, founded an English College at Douay, where aspirants to the priesthood might obtain the instruction denied to them at home. During the first five years of its existence, this college trained and sent back to England over 100 priests. Another of his claims to the gratitude of English-speaking Catholics is that while professor at Douay, in collaboration with Gregory Martins and Richard Bristow he translated the Bible from the Latin Vulgate into English. This translation is known as the Douay Bible (q. v.) and is the one generally used by Catholics in England and America.

Allen, William, American preacher and miscellaneous writer: b. Pittsfield, Mass., 2 Jan. 1784; d. Northampton, Mass., 16 July 1868. He became president of Dartmouth University in 1817, and was president of Bowdoin College 1820–39. Of numerous works, both in prose and verse, the best known is 'American Biographical and Historical Dictionary' (3d ed. 1857).

Allen, William, American public official: b. Edenton, N. C., 1806; d. 11 July 1879. He studied law at Chillicothe, Ohio, was admitted to the bar at 21, and in three years had become noted as a coming leader. In 1832 he was elected (Democratic) member of Congress by one vote, the youngest member of the Twenty-second Congress. He was a leading champion of his party; took an active part in the 1836 canvass for Van Buren, and was given the United States senatorship by the Democrats at the earliest age of any senator before or since. He was re-elected in 1843, and in 1848 was tendered the nomination for the Presidency by the supporters of both Cass and Van Buren, but refused from loyalty to Cass. After the expiration of his term Mr. Allen took no further part in public life for nearly a quarter of a century, till 1873, when he was elected governor of Ohio: again nominated in 1875 as a "rag-money" champion, he was defeated by Rutherford B. Hayes. His stentorian voice gave him the Congressional nickname of the "Ohio Gong"; and he is credited with the famous slogan of the campaign of 1844 on the question of the northwestern boundary, "Fifty-four forty or fight."

Allen, William Francis, historian and essayist: b. Northborough, Mass., 5 Sept. 1830; d. 9 Dec. 1889. He graduated Harvard in 1851; studied at Berlin, Göttingen, and Rome, 1854–6; was professor of Latin and history in the University of Wisconsin 1867–89 and is noted as a scholar of wide and varied attainments, equally strong in the linguistic, historical, and archæological sides of his subjects. A list of his writings covers thirty 12mo. pages. Three of especial interest may be found in the Transactions of the American Philological Association for the years given: 'The Battle of Mons Graupius' (1880); '*Lex Curiata de Imperio*' (1888); 'The Monetary Crisis in Rome, A.D. 33' (1887).

Allen, William Henry, American naval officer: b. Providence, R. I., 1784; d. 1813. He entered the navy in 1800 and served in some of the greatest naval battles in American history.

For bravery displayed on the Chesapeake and United States he was made commander of the brig Argus in June 1813. He did great damage to English commerce in the Irish Channel, capturing in a month 27 ships. In a few days the Argus was taken by the English brig Pelican. In the battle Allen was shot, died soon afterward, and was buried with military honors in Plymouth, England.

Allen, William Vincent, American politician: b. 1847; leader in the People's or Populist party; became senator from Nebraska in 1893. In the memorable special session of 1893 he took a prominent part in opposing the repeal of the silver purchase act. He was chairman of the Populist national convention of 1896, and instrumental in obtaining its indorsement of William Jennings Bryan for President.

Allen, Willis Boyd, American writer: b. Maine, 1855. Besides a collection of verse, entitled 'In the Morning,' he has written several books for young people, including 'The Red Mountain of Alaska,' 'Pine Cones,' (1885); 'Silver Rags' (1886), 'Kelp,' 'Navy Blue' (1888); 'The Mammoth-Hunters.'

Allen, Zachariah, American inventor: b. Providence, R. I., 15 Sept. 1795; d. 17 March 1882. He was graduated at Brown University in 1813, and was admitted to the bar in 1815, but soon turned his attention to manufacturing. He traveled in Europe 1825, to study manufacturing methods, and on his return published the 'Practical Tourist.' He invented in 1821 the first hot-air furnace for household use; in 1833 the automatic cut-off valve for steam engines; and later an improved fire engine, extension rollers, and a storage system for water-power. He first suggested the system of mutual mill insurance, and drafted laws to regulate the sale of explosive oils. He was the first to compute the motive power of Niagara. He was a member from 1822 and president from 1880 of the Rhode Island Historical Society. He published 'The Science of Mechanics' (1829); 'Philosophy of the Mechanics of Nature' (1851); 'Solar Light and Heat, the Source and Supply' (1879); etc.

Allen-a-Dale, the friend and confidant of Robin Hood in the Robin Hood ballads.

Allenites. See Allen, Henry.

Allentown, Pa., city and county-seat of Lehigh County on the Lehigh Valley, the Philadelphia & Reading, and the Central of New Jersey R.R.'s, six miles S.W. of Bethlehem, 18 miles S.W. of Easton, and 55 miles N.W. of Philadelphia. It was founded about 1752 by William Allen, Esq., Chief Justice of the Province of Pennsylvania, father-in-law of Governor John Penn, and a great friend of the Penn family, from whom he derived his grants of land, and named Allentown in honor of its founder. Here Colonel James Bird displayed much heroism in the wars against the Indians; here, during the Revolution, the bells now in Christ Church, Philadelphia, were concealed by the Americans; and here, in 1799, John Fries (q.v.), of "Fries Rebellion" notoriety, fomented the German opposition to the "window tax." Inhabited at first by a few wealthy and unenterprising Germans, and by the influence of the neighboring towns cut off for several years from the different post routes, it remained unprogressive until, in 1811, by the division of Northampton County, it became the seat of justice of Lehigh County, and by an act of the Legislature passed 18 Mar. 1811, was incorporated as Northampton Borough. With its advance to the rank of a county-seat, the town improved rapidly, and its accessibility to deposits of limestone, iron ore, zinc, cement, etc., added to its increasing importance in trade and wealth. An inadequate water supply, one of its chief drawbacks, was removed in 1828 by the organization of a water company, and the city now owns and operates its water-works. In 1838 the original name of the town was restored, and in 1867 it received a special charter. Allentown now ranks second only to Paterson in the United States for the manufacture of silks, and has considerable manufactures of iron and steel, furniture, cement, thread, and cigars. The large courthouse, fine hospital, spacious prison, and other public buildings are of hewn limestone. The numerous educational establishments include Muhlenberg College, a Lutheran institution founded in 1867; the Allentown College for Women; a theological seminary, and a military institute. The city is governed under a charter of 1889 by a council divided into an upper house of 11 members and a lower house of 22 members, presided over by a mayor, who is elected triennially. The city's annual income is about $450,000. The inhabitants are largely of German descent, and German is still commonly spoken. Pop. (1890) 25,228; (1900) 35,416.

Allerton, Isaac, one of the 'Pilgrim Fathers': b. England about 1583; d. New Haven, Conn., 1659. He was one of the most influential members of the Plymouth Colony, but on account of some disagreement with his associates he removed to New Amsterdam in 1631, and later to New Haven. Mary Allerton, his daughter, was the latest survivor of the original Mayflower company.

All Hallows. See All Saints' Day.

Alliaceous Plants. See Allium.

Alliance, O., city of Stark co., situated on the Mahoning River, at the junction of the Alliance & Mahoning, Lake Erie, Pittsburg, Fort Wayne & Chicago, and other R.R.'s, 56 miles S.S.E. of Cleveland. It is in a thriving agricultural region, and is a busy industrial centre with manufactures of agricultural implements, white lead, terra cotta ware, and extensive steel works, manufacturing heavy machinery, structural iron work, boilers, cranes, gun carriages, steam hammers, and drop forgings. The first settlement, made in 1838, was known at Freedom until 1850, when the name was altered to Alliance. Its principal educational establishment, Mount Union College, a Methodist Episcopal institution, was founded in 1846. Alliance, incorporated as a city under a charter of 1854, is governed by a mayor, elected every two years, and by a council of 12 members. Pop. (1890) 7,607; (1900) 8,974.

Alliance of the Reformed Churches Holding the Presbyterian System, a voluntary organization popularly styled the Presbyterian Alliance, formed in London in 1875. Its councils have much moral significance but possess no legislative authority. Rather more than 90 Presbyterian bodies are represented in the Alliance, with some 25,000,000 adherents in all parts of the world. The first General Council of the

Alliance met in Edinburgh in 1877; and the subsequent councils were held in Philadelphia, 1880; Belfast, 1884; London, 1888; Toronto, 1892; Glasgow, 1896; Washington, 1899.

Allibone, Samuel Austin, bibliographer and librarian: b. Philadelphia, 17 April 1816; d. Lucerne, Switzerland, 2 Sept. 1889. For a time he engaged in mercantile pursuits; was book-editor of the American Sunday-School Union, 1867–73; and in 1879 was appointed librarian of the Lenox Library, New York. He is best known by his 'Critical Dictionary of English Literature and British and American Authors' (3 vols. 1854–71), a monumental work that cost him 20 years of labor. It contains notices of 46,499 authors, with extracts from reviews of their works, and 40 classified indexes of subjects. It is an indispensable reference work for libraries and students. A supplement containing over 37,000 authors, by John Foster Kirk, appeared in two volumes, 1891. Others of Allibone's works are: 'Poetical Quotations from Chaucer to Tennyson' (1873); 'Prose Quotations from Socrates to Macaulay' (1876); 'Great Authors of all Ages: Selections' (1880).

Allice, or **Allis** (Fr. *alose,* from Lat. *alausa*), the larger European shad (*Alosa vulgaris*), about 20 inches long. There is but one other shad in Europe, the twaite. In the Rhine valley both are called *maifisch.* See SHAD; TWAITE.

Allier, äl-lē-ā, a central department of France, intersected by the river Allier and partly bounded by the Loire; surface diversified by offsets of the Cevennes and other ranges, rising in the south to over 4,000 feet, and in general richly wooded. It has extensive beds of coal as well as other minerals, which are actively worked, there being several flourishing centres of mining and manufacturing enterprise; mineral waters at Vichy, Bourbon, L'Archambault, etc. Large numbers of sheep and cattle are bred. Area, 2,822 miles. Capital, Moulins. Pop. 500,000.

Allier, a river of France, tributary of the Loire, rising in the department of Lozère and flowing northward about 200 miles through Lozère, Upper Loire, Puy de Dôme, and Allier.

Allies, Jabez, English antiquary, and one of the earliest writers on folklore: b. Sulsley, 22 Oct. 1787; d. 29 Jan. 1856. He devoted his life to the study of the antiquities in his native county, embodying the results in his monumental work, 'The Ancient British, Roman, and Saxon Antiquities and Folklore of Worcestershire' (1852).

Alligator, the name of a genus of crocodilian reptiles derived from a corruption of the Spanish *el lagarto,* "lizard," from the Latin *lacertus,* a lizard. Alligators differ from crocodiles mainly in having relatively short and broad snouts and by the circumstance that as a rule the first and fourth tooth on each side of the lower jaw enter into pits in the upper jaw, whereas those of crocodiles slide outside of the jaw and are visible. The caymans of South America may be included in the general term. These reptiles are confined mainly to the rivers of the New World, in which they typically represent the crocodiles of the eastern hemisphere, but there is one species in China (*Alligator sinensis*) first made known in 1879, and resembling the South American species. The best-known species are the alligator of the southern States (*Alligator mississippiensis*); the cayman of Surinam and Guiana (*A palpebrosus*), and the spectacled alligator (*A. sclerops*), found in Brazil. In the water a full-grown alligator is a formidable animal, on account of its great size and strength. These reptiles swim with wonderful celerity, impelled by their long, laterally-compressed, and powerful tails. On land their motions are proportionally slow and embarrassed, owing to their weight, the shortness of their legs, and generally unwieldy proportions. It grows to the length of 15 or possibly 20 feet, and is covered above by a dense armor of horny scales.

Under the throat of this animal are two openings or pores, the excretory ducts from glands which pour out a strong, musky fluid, giving the alligator a peculiarly unpleasant smell. In the spring of the year, when the males are under the excitement of the sexual propensity, they frequently utter a loud roar, which, from its harshness and reverberation, resembles distant thunder, especially where numbers are at the same time engaged. At this period frequent and terrible battles take place between the males, which terminate in the discomfiture and retreat of one of the parties. The females make their nests in a curious manner, on the banks of rivers or lagoons, generally in the marshes, along which, at a short distance from the water, the nests are arranged somewhat like an encampment. They are obtuse cones four feet high, and about four feet in diameter at the base, built of mud and grass. A floor of such mortar is first spread upon the ground, on which a layer of eggs, having hard shells and larger than those of a common hen, are deposited. Upon these another layer of mortar, seven or eight inches in thickness, is spread, and then another bed of eggs; and this is repeated nearly to the top. From 100 to 200 eggs may be found in one nest. It is not ascertained whether each female watches her own nest exclusively, or attends to more than her own brood. It is unquestionable, however, that the females keep near the nests and take the young under their vigilant care as soon as they are hatched, defending them with great perseverance and courage. The young may be seen following the mother through the water like a brood of chickens following a hen. When basking in the sun on shore, the young are heard whining and yelping about the mother, not unlike young puppies. In situations where alligators are not exposed to much disturbance the sites of the nests appear to be very much frequented, as the grass and reeds are beaten down for several acres around. The young, when first hatched, are very feeble and helpless, and are devoured by birds of prey, soft-shelled turtles, etc., as well as by the male alligators, until they grow old enough to defend themselves. As the eggs are also eagerly sought by vultures and other animals the race would speedily become extinct but for the great fecundity of the females.

The alligator is generally considered as disposed to retire from man, but this is only where they are frequently disturbed. In situations where they are seldom or never interrupted they have shown a ferocity and perseverance of the most alarming character in attacking individuals in boats, rearing their heads from the water

and snapping their jaws in a threatening manner. At present alligators, though still numerous in the remoter parts of Florida and Louisiana, are no longer regarded as very dangerous. Their numbers annually decrease, and at no distant period they must be nearly, if not quite, exterminated. In the winter the alligators spend a great part of their time in deep holes, which they make in the marshy banks of rivers, etc. They feed on fishes, reptiles, small quadrupeds (dogs if they can get them), or carrion, and though very voracious are capable of existing a long time without food. Compare CROCODILE; and see CAYMAN; JACARE.

Alligator-apple. See CUSTARD-APPLE.

Alligator-fish, one of the *Agonidæ,* a family of fish whose slender bodies are armored by large bony plates. One species 12 inches long (*Podothecus acipenserinus*) is found on the northern Pacific coast.

Alligator-gar, the immense greenish colored gar (*Litholepis tristæchus*) found in the southern States and southward through North America, and sometimes measuring 10 feet. See GAR.

Alligator-lizard, any member of the genus *Sceloporus,* which, although iguanid, has many small species without the typical iguanid characteristics. They abound in Mexico and the southwestern United States, and one species (*Sceloporus undulatus*) is the familiar "fence lizard" of the colder States. Though often inconspicuously colored on the back except for black crosslines, the throat and inferior surfaces are generally striking in color, and frequently there are light lines along the sides. They are often ignorantly called poisonous, but all are harmless.

Alligator-pear, or **Avocado-pear,** a tree, *Persea gratissima,* of the natural order *Lauraceæ,* indigenous to subtropical and tropical America and widely cultivated in warm countries for its more or less pear-shaped, purple- or green-skinned fruits, each of which contains a single seed embedded in a yellowish-green edible marrow-like pulp. Wherever it grows the alligator-pear is highly prized as a salad and is usually served with pepper, salt, and vinegar, or with wine and spice, but natives of temperate climates usually have to acquire a taste for it. It is rich in oil, which may be used in soap-making and in lighting. The seeds yield a black dye. Little beyond the selection of chance seedlings has been done to obtain improved varieties. Seedlings are easily raised and begin to bear in about five years if planted in good soil in warm places. Except in southern Florida and southern California the avocado-pear does not produce palatable fruit in the United States. The American market, therefore, which is limited to the larger cities, is mainly supplied from Hawaii, Mexico, and the West Indies. The fruit is sometimes called midshipman's butter and aguacate.

Alligator-terrapin, -tortoise, or **-turtle,** the snapping-turtle; more particularly, a very large species (*Macrochelys lacertina*) which is eaten and esteemed as a delicacy in the lower valley of the Mississippi. It sometimes weighs 50 pounds.

Allingham, Helen (PATERSON), English artist: b. 26 Sept. 1848. Received her art education in the Royal Academy Schools, and married the Irish poet, William Allingham (q.v.), in 1874. She has drawn much in black and white for the 'Graphic' and other periodicals, and her work as an illustrator has been much admired.

Allingham, William, Irish poet: b. Ballyshannon, Ireland, 19 March 1824; d. Hampstead, 18 Nov. 1889. From 1846 to his retirement in 1870 he held various posts in the Irish customs service. He was sub-editor of 'Fraser's Magazine,' 1870–4, when he succeeded James Anthony Froude as editor, and conducted it with ability until 1879. At its best Allingham's poetry is excellent, being simple, clear, and graceful, and whether pathetic, sportive, or descriptive is always characterized by delicate artistic expression. His best work is in the volume called 'Day and Night Songs' (1854). 'Laurence Bloomfield in Ireland' (1864), a long poem which has been called "the epic of Irish philanthropic landlordism," has a wealth of fine description, but was not a public success. Other volumes are, 'Poems' (1850), 'The Ballad Book' (1864), 'Songs, Ballads, and Stories' (1877). 'Collected Poetical Works' (6 vols. 1888–93).

Allison, William Boyd, American legislator: b. Perry, Ohio, 2 March 1829. A farmer's son, he received an excellent education, first at Allegheny College, Pa., then at Western Reserve College, Ohio. Studying law, he practised in his native State till 1857, when he removed to Dubuque, Iowa. An ardent Republican and a trusted local political leader, he was sent as a delegate to the Republican national convention in Chicago in 1860, which nominated Lincoln. In the early part of the Civil War he served on the governor's staff, and was actively engaged in raising troops for the Union army. In 1863 he was elected to Congress, and served by successive re-elections till 1869; on 4 March 1873 he was elected to the United States Senate, and has been four times re-elected, in 1878, 1884, 1890, and 1896, his nearly 30 years of service making him one of the oldest as he has always been among the most influential leaders. He has served on many important committees; and as chairman of the Finance Committee in 1878 was the chief author of the bill that committee reported for the purchase of silver bullion, usually known as the Bland-Allison Act, for the purchase of silver bullion (see BLAND SILVER BILL), a compromise from the free-coinage bill of Congressman Bland. He has repeatedly been a strong candidate in Republican national conventions for the presidency; and was offered the secretaryship of the treasury by both Garfield and Harrison. In 1892 he was a representative of the United States at the Brussels Monetary Conference.

All is True, a play attributed to Shakespeare. The burning of the Globe Theatre (29 March 1613) while the piece was being played destroyed the manuscript. Parts of the drama were incorporated into the play of 'Henry VIII.'

Alliteration, the succession or frequent occurrence of words beginning with the same consonant. In the older Scandinavian, German, and Anglo-Saxon poetry it served instead of rhyme. It is found in early English poetry with the same function. As thus used it had a certain regularity of accent and emphasis. In 'Piers Plow-

man' the line is constructed with two hemistichs, the former with two words beginning with the alliterative letter, and the latter with one, thus:

"Her *r*obe was full *r*ich with *r*ed scarlet engreyned."

The poetry of widely separated nations exhibits this device, it being found both in India and in Finland. It still remains in Icelandic poetry. Early in the 17th century English writers ran to great extravagance in the use of alliteration, both in prose and poetry. It is said that preachers from their pulpits addressed their hearers as « chickens of the church » and « sweet swallows of salvation.» No other device of composition so easily lends itself to fanciful conceits or ingenious trifling. The ease with which devices may be marshaled would hardly tend to make the ordinary reader appreciative of Churchill's description of himself as one

"Who often, but without success, had prayed
For apt alliteration's artful aid."

But the couplet itself is a striking proof of its own truth, for it shows that the poet did not know what alliteration is: it must be of consonants, not vowels, and even so his *a*'s are alike only to the eye, not the ear. All good poets have used it to lend musical beauty or emphasis to their verse, though it can be over-used or misused. Following are a few from the chief American poets:

"And the *s*park *s*truck out by that *s*teed in his *f*light
Kindled the land into *f*lame with its heat."
LONGFELLOW.

"It carves the *b*ow of *b*eauty there,
And the *r*ipples in *r*hymes the oar forsake."
EMERSON.

"Of *w*ailing *w*inds, and naked *w*oods." BRYANT.

"And *h*ark! *h*ow clear bold chanticleer,
*W*armed with the new *w*ine of the year."
LOWELL.

"*S*tole with *s*oft *s*teps the shining *s*tairway through."
HOLMES.

"What a *t*ale of *t*error now their *t*urbulency *t*ells!"
POE.

"Across the *m*ournful *m*arbles play." WHITTIER.

Allium, a genus of about 250 perennial, rarely biennial, bulbous herbs of the natural order *Liliaceæ,* mainly indigenous to the colder parts of the northern hemisphere. The leaves are generally long and narrow, often, however, cylindrical and hollow; the flowers in umbels, often with bulblets among them. Many of the species are economically important; for instance, *Allium cepa,* the onion; *Allium sativum,* garlic; *Allium porrum,* leek; *Allium ascalonicum,* shallot; *Allium schœnoprasum,* chive; *Allium scorodoprasum,* rocambole, each of which is treated separately under its common name. Several uncultivated members of the genus are also used as food in countries where they grow wild. *Allium vineale,* wild onion or wild garlic, a European species introduced into the United States, is a troublesome weed, especially in New England pastures, since it imparts a strong flavor of garlic to the milk of cows feeding upon it. (See GARLIC.) Many species are natives of the United States, but none of them have been cultivated for food; some, however, are planted for ornament. Perhaps the most common eastern species are *Allium cernuum, Allium canadense,* and *Allium tricoccum,* the last generally known as the wild leek, a broad-leaved species which grows in moist woods, from Maine to North Carolina and westward to Wisconsin. Some of the hardy species are grown for ornament in gardens; for example, *Allium moly* and *Allium roseum,* from Europe; *Allium victorialis,* from Siberia; *Allium acuminatum,* from the western States. Others, especially *Allium neapolitanum,* a tender European species, are often grown in greenhouses.

Allmers, Hermann Ludwig, äl-merss, hĕr'man lüt'vik, German poet and author: b. Rechtenfleth, 11 Feb. 1821. His 'Idle Days in Rome' (1869; 9th ed. 1896) was widely read. Others are: 'Captain Böse' (1882); 'Fromm und Frei' (1889), a volume of religious poems; 'From an Old and Young Past Time' (1895); 'Collected Works' (Oldenburg, 6 vols. 1891–5).

Allmouth, a fish. See GOOSEFISH.

Alloa, a river port of Scotland, pleasantly situated on the north side of the Forth, 5 m. from Stirling, and in the county of Clackmannan. It is irregularly built, but contains some good streets and buildings, including the parish church, the county court-house, the town-hall, and the public baths. It carries on several manufactures, chief of which are ale, whiskey, woolen yarn, and bottles. There are some large collieries in the neighborhood. Alloa has an excellent harbor, from which it exports coal, ale, and fire-brick, and imports timber, hemp, oak-bark, grain, etc. A new wet dock was opened in 1881. The river is here crossed by a viaduct of the North British Railway. There is an ancient tower in the vicinity, once the residence of the Erskine family. Pop. (1901) 11,417.

Allobroges, the name of a people who lived in ancient Gallia Narbonensis and occupied the country below the Lake of Geneva and the Rhone, now included in Savoy and the French province of Dauphiné. They long struggled for their independence against the Romans, but were finally subjugated by Fabius Maximus.

Allocution, an address, a term particularly applied to certain addresses made by the Pope to the cardinals.

Allodium («without vassalage»). Applied to lands, allodium, or allodial tenure, signifies an estate held by absolute ownership, without regarding any superior to whom any duty is due on account thereof. The title to land in the United States is essentially allodial, and every tenant in fee simple has an absolute and unqualified dominion over it; still, in technical language, his estate is said to be in fee, a term implying a feudal relation, although such a relation has ceased to exist in any form, while in many of the States of the Union the lands have been declared to be allodial.

Allopathy. See THERAPEUTICS.

Al'lophane, al'ō-fān; from the Greek *allos,* «other,» and *phanos,* «appearing,» in allusion to its change of appearance before the blowpipe, a native silicate of aluminum, having the formula $Al_2SiO_5 + 5H_2O$, and occurring in thin, amorphous, brittle incrustations, with a hardness of 3, and a specific gravity of about 1.87. It is found in a great variety of colors, due to the presence of other minerals. In the United States it occurs in Massachusetts, Connecticut, Pennsylvania, and Tennessee.

Allosaurus, an extinct carnivorous dinosaur of gigantic size, inhabiting North America during the Jurassic Period. It was one of the largest of flesh-eating animals, exceeding 30 feet in length, and comparable with an elephant in bulk. The animal was a biped with long hind legs, small fore legs not reaching the ground, and long massive tail. The jaws are three feet long, with pointed, sharp-edged teeth, and the toes armed with large sharp claws, those of the fore foot being especially powerful. The hind feet somewhat resemble those of birds. Fossil skeletons of herbivorous dinosaurs frequently show deep scratches and scorings on the softer edges of the bone, and broken-off teeth of Allosaurus are very often found associated with them, showing that this animal preyed on the carcasses of his huge herbivorous contemporaries; it was well adapted also by its teeth and claws to attack them when alive, and was probably their especial foe. See DINOSAUR.

Allotropy, a-lot'rō-pi, or **Allotropism** (from the Greek *allos*, "another," and *tropos*, "manner"), the property exhibited by certain substances of existing in two or more different states distinguished from each other by different properties. The most familiar case of allotropy is afforded by carbon, which exists in a number of allotropic modifications, of which charcoal, graphite, and the diamond are familiar examples. Allotropy is not exhibited by the metals to any marked degree (see, however, SILVER). Sulphur exhibits many allotropic forms, of which the following are the best known: (1) It occurs in rhombic crystals, having a sp. gr. of 2.07, melting at 235° F., and soluble in carbon disulphid; (2) in monoclinic crystals, having a sp. gr. of 1.96, melting at 243° F., and soluble in carbon disulphid; (3) in an amorphous plastic state, insoluble in carbon disulphid; (4) immediately above its melting-point it is thin, clear, and amber-colored; (5) at about 400° F. it becomes thick and dark; and (6) at about 650° F. it is again thin, but remains dark.

Ozone is a familiar allotropic form of oxygen, produced when the silent electric discharge is allowed to act upon oxygen. It is known that the molecule of oxygen contains two atoms, and that the molecule of ozone contains three atoms. This suggests that allotropy, in all cases, may be due to a similar change in the number of atoms present in a molecule; but so little is known of the ultimate structure of solids and liquids that speculation of this sort is of no great value.

Most of the non-metallic elements have allotropic modifications, and remarkable cases of allotropy are observed among chemical compounds. In the case of a compound, two states of a substance having the same chemical composition are said to be isomeric when their constituents are combined by different modes of atomic linkage; and they are said to be allotropic when the kind of atomic linkage is the same in both cases. See ISOMERISM.

Allouez, ä-lö-ā', **Claude Jean,** French Jesuit missionary: b. France, 1620; d. Indiana, 1690. He explored portions of the valley of the Mississippi and the Lake Superior region, founding the Mission of the Holy Ghost on Lake Superior in 1665, and continuing at Kaskaskia the mission established there by Marquette. See autobiography included in the 'Jesuit Relations' (1900).

Alloway, Thomas Jefferson, a Canadian surgeon: b. 1847; was graduated at the Medical Department of McGill University in 1869; spent a year in advance study in London; served three years in the British navy; and in 1894 became gynæcologist-in-chief to the Montreal General Hospital and assistant professor of gynæcology in McGill University. Dr. Alloway has made a world-wide reputation.

Al'loway, a parish of Scotland, now included in Ayr parish. Here Burns was born in 1759, and the "auld haunted kirk" near his birthplace was the scene of the dance of witches in 'Tam o' Shanter'.

Allox'an, a-lok'san, a substance produced by the action of dilute nitric acid upon uric acid, and having the formula $C_4H_2N_2O_4$. It is freely soluble in water and crystallizes in the trimetric system when a saturated solution is allowed to cool, and in monoclinic prisms when deposited by evaporation from a warm solution. It is converted into alloxantin ($C_8H_4N_4O_7$) by the action of $SnCl_2$ and other reducing agents, and into alloxanic acid ($C_4H_4N_2O_5$) by the action of the fixed alkalis. Ammonia combines with it to form murexid, a substance that was used about the middle of the 19th century for dyeing silk and wool purple and red, but which was soon displaced by the aniline colors.

Alloy' (Latin, *ad* to, and *ligare*, to bind), an intimate and apparently homogeneous mixture of different metals, usually prepared by combining the constituents in a state of fusion. From the earliest times alloys have been used for coins, implements, and works of art; but notwithstanding this fact no general and detailed theory of their nature and properties has yet been given. There is some evidence that certain metals form definite chemical combinations with one another when mixed in proper proportions, and until recently it was thought that alloys consist of certain definite compounds of this sort mixed with more or less of one or more of the constituent metals in the free state. While this may be the case, the modern tendency is strongly toward regarding alloys as solutions of metals in one another. See SOLUTION.

Some metals will not mix when melted, or will not mix in all proportions; and even when a desired mixture can be obtained in a state of fusion it not infrequently happens that a more or less complete separation of the constituent metals occurs at the moment of solidification. Attempts have therefore been made to prepare alloys by other methods. In some cases it has been found possible to obtain true alloys by mixing the constituents in a pulverized or finely-ground state, and then consolidating them under great pressure. In other cases alloys can be formed by the simultaneous electro-deposition of their constituents, or by the electro-deposition of alternate thin layers of those constituents. The success of this latter method depends upon the known fact that a metal deposited electrolytically often penetrates, to a measurable depth, the one upon which it is deposited. At the present time the alloys used in the arts are

produced almost exclusively by fusion; the various other methods that are known being confined to the laboratory.

The physical properties of alloys can seldom be inferred from those of their constituent metals. Thus speculum metal is brittle, like glass, although both copper and tin (which are its sole constituents) are ductile. A very small change in the composition of an alloy will often make a marked difference in its physical properties; and such apparently trifling circumstances as the order in which the components are added are also frequently of the greatest importance. The melting point of an alloy is usually lower than the melting points of its constituents would appear to indicate; but even this is not an invariable rule. If all possible combinations are made by fusing together a given pair (or group) of metals in all proportions, by a constant method of manipulation, it is commonly found that there is one particular alloy that has a lower melting point than any other combination of the same metals. The alloy having this property is known as the «eutectic» alloy of the metals that it contains.

By a similar systematic variation in the proportion of the components we can find out what alloy of any given metals possesses any particular physical attribute to a maximum or minimum degree. Thus Thurston has made an elaborate investigation of the strength of the copper-tin-zinc (or «kalchoid») alloys, and has shown that the strongest of these contains 57 per cent of copper, 1 per cent of tin, and 42 per cent of zinc. An alloy having 56 per cent of copper, 2 per cent of tin, and 42 per cent of zinc has nearly the same strength, however, and is more generally useful because of its greater ductility. Thurston has called the compositions, copper, 58 to 54; tin, ½ to 2½; zinc, 44 to 40, the «maximum bronzes.» Tobin bronze, containing 58.22 per cent of copper, 2.30 per cent of tin, and 39.48 of zinc, belongs in this class, and has shown a tenacity as high as 66,500 pounds per square inch of original sectional area. Like Thurston's «maximum bronze,» Tobin's alloy can be forged or rolled at a low red heat, or worked cold. When cold-rolled its tensile strength may be raised to 104,000 pounds per square inch without any serious corresponding loss of ductility.

Properly speaking, neither Tobin's alloy nor Thurston's is a «bronze.» Strictly, bronze is an alloy of copper and tin, and brass is an alloy of copper and zinc; but in practice small amounts of zinc are often added to the bronzes, and small amounts of tin to the brasses, so that there is no longer any hard and fast line between the two.

Guillaume, of the International Bureau of Weights and Measures, has recently obtained some remarkable results with alloys of nickel and iron, which afford excellent illustrations of the fact that little can be safely inferred concerning the properties of an alloy from those of its constituents. Thus it was found that an alloy containing about 25 per cent of nickel is practically non-magnetic, being as insensible to the action of a magnet as copper, although iron and nickel are the two most magnetic substances known. Alloys containing 24 per cent (or less) of nickel are magnetically irreversible, in the sense that they do not lose and regain their magnetism at the same temperature. Thus alloy containing 24 per cent of nickel loses its magnetism at a cherry-red heat, and does not become magnetic again until it has been exposed to a temperature in the neighborhood of 32° F. Equally remarkable results were obtained in studying the coefficients of expansion of nickel-steel. It was found, for example, that an alloy containing 36 per cent of nickel has a coefficient of expansion which is almost negligible, even in refined scientific work. This particular alloy has been called «invar,» because its length is so nearly invariable under the influence of heat. Nearly every pendulum clock that is made in Germany to-day has its pendulum rod made of invar, except possibly some of the cheapest grades. (For further information concerning nickel-steel alloys see the 'Engineering Magazine,' October 1901, page 79; and the 'American Machinist,' 8 Jan. 1903, page 67.) The general composition of some of the commoner alloys is given in the following table, but it should be remembered that these proportions (which are expressed in percentages by weight) are variable in practice to a certain extent:

COMPOSITION OF COMMON ALLOYS.

Name	Copper	Tin	Zinc	Lead	Other Metals
Gun metal	91	9			
Bell metal	75	25			
Phosphor bronze	92½	7			½ phosphor.
Aluminum bronze	90				10 aluminum
Valve metal	88	10	2		
Brass (common)	66⅔		33⅓		
Muntz metal	60		40		
Delta metal	56		42		2 iron
Brazing metal (soft)	50	12½	37½		
Brazing metal (medium)	50		50		
Brazing metal (hard)	75		25		
German silver	60		20		20 nickel
Speculum metal	67	33			
Common solder		50		50	
Fine solder		66⅔		33⅓	
Babbitt metal	3	89			8 antimony
Pewter		80		20	
Britannia metal		90			10 antimony
Type metal				80	20 antimony
Aich metal	59		39		2 iron
Dutch metal	85		15		
Newton's metal		19		31	50 bismuth
Rose's metal		25		25	50 bismuth

Both the gold and the silver coins of the United States contain 90 per cent of pure metal. The silver coins contain 10 per cent of copper, and the gold coins contain 10 per cent of copper alloy, not more than one tenth of which can be silver.

(See Thurston's 'Brasses, Bronzes, and Other Alloys,' New York 1893, for valuable and extensive information on alloys containing copper, zinc, lead, and tin. For alloys of nearly constant electrical resistance see RESISTANCE, ELECTRICAL.

All Saints' Bay, or **Bahia de Todos os Santos,** a bay on the coast of the State of Bahia in Brazil, forming an excellent natural harbor. On its east side stands the port of Bahia. The neighboring country is well adapted for the cultivation of rice and sugar-cane.

All Saints' Day, a festival instituted by Pope Boniface IV., early in the 7th century, on the occasion of his transforming the Roman

heathen Pantheon into a Christian temple or church, and consecrating it to the Virgin Mary and all the martyrs. It is kept by the Roman Catholic Church, and by churches in communion with the Church of England on 1 November, and by the Greek Church on the Sunday after Whitsunday. It is designed, as its name implies, to honor all departed saints, and was formerly called All-hallows. In many American churches a custom has grown up of making the Sunday nearest 1 November the occasion of a service in memory of those who have died during the year.

All Sorts and Conditions of Men, a novel by Sir Walter Besant. The famous People's Palace of East London had its origin in this story; and because of it Besant was knighted. The story concerns chiefly two characters,—the very wealthy orphan, Angela Messenger, and Harry Goslett, ward of Lord Joscelyn. Miss Messenger, after graduating with honors at Newnham, resolves to examine into the condition of the people of Stepney Green, in the Whitechapel region, where she owns great possessions. To indicate to the working women of East London a way of escape from the meanness, misery, and poverty of their lives, she sets up among them a co-operative dressmaking establishment, she herself living with her work-girls. Her goodness and wealth bring happiness to many. The book ends with the opening of the People's Palace, and with the heroine's marriage to Harry Goslett.

All Souls' College, Oxford, was founded in 1437 by Henry Chichele, archbishop of Canterbury, for a warden, 40 fellows, 2 chaplains, and clerks. The present arrangement of fellowships was fixed by statutes which came into operation in 1882.

All Souls' Day, the day on which the Catholic Church commemorates all the faithful deceased. It was first enjoined in the 11th century by Odile, Abbot of Cluny, on the monastic order of which he was the head, and soon afterward came to be adopted by the Church generally. It is observed on 2 November.

Allspice, or PIMENTA, is the dried berry of a West Indian species of myrtle (*Myrtus pimenta*) which grows to the height of 20 feet and upward, and has somewhat oval leaves about 4 inches long, of a deep shining green color, and numerous branches of white flowers, each with four small petals. This tree is by some botanists referred to the genus *Eugenia* and called *E. pimenta*. Others again constitute a genus *Pimenta*, the present species being *P. officinalis*. In the whole vegetable creation there is scarcely any tree more beautiful or more fragrant than a young pimenta-tree about the month of July. Branched on all sides, richly clad with deep green leaves, which are relieved by an exuberance of white and richly aromatic flowers, it attracts the notice of all who approach it. About the month of September, and not long after the blossoms have fallen, the berries are in a fit state to be gathered. At this time, though not quite ripe, they are full grown and about the size of peppercorns. They are gathered by hand. The berries are spread in the sun to be dried, an operation that requires great care, from the necessity of keeping them entirely free from moisture. By the drying they lose their green color and become a reddish brown; the process is known to be complete by their change of color and by the rattling of the seeds within the berries. They are then packed into bags or hogsheads for the market. When the berries are quite ripe they are of a dark purple color and filled with a sweet pulp. Pimenta is thought to resemble in flavor a mixture of cinnamon, nutmegs, and cloves, whence it has obtained the name allspice. For its use in medicine see CONDIMENTS.

Allston, Margaret. See BERGENGREN, ANNA; FARQUHAR, ANNA.

Allston, Theodosia Burr. See BURR, THEODOSIA.

Allston, Washington, American painter and author: b. Waccamaw, S. C., 5 Nov. 1779; d. Cambridge, Mass., 9 July 1843. He graduated at Harvard, 1800; studied art in Europe, 1801–9; resided in England, 1811–18; and opened a studio in Boston, Mass., 1818. His painting 'The Dead Man Revived' was awarded a prize of 200 guineas. Other well-known works are, 'The Prophet Jeremiah'; 'Spanish Girl'; 'Spalatro's Vision of the Bloody Hand'; 'Belshazzar's Feast,' and portraits of Benjamin West, Coleridge, and himself. He has a high reputation as a colorist and has been called the "American Titian." His writings comprise, 'The Sylphs of the Seasons' (1813); 'Monaldi,' a romance of Italian life (1841), and 'Lectures on Art, and Poems' (1850). See Ware's 'Lectures on the Works and Genius of W. Allston' (1852), and the 'Life' by Flagg (1892).

All's Well that Ends Well, a play by Shakespeare, the story of which came to the poet from Boccaccio through Paynter's 'Palace of Pleasure.' It tells how Helena de Narbon forced her love on a handsome and proud young French nobleman, Bertram de Rousillon, with whom she had been brought up from childhood. It is a tale of husband-catching by a curious kind of trick; but Shakespeare endows Helena with such virtues that we excuse and applaud her action. Hence all's well that ends well. She heals the king, asks for and accepts Bertram as her reward, and is married. But the proud boy flies to the Florentine wars on his wedding-day, leaving his marriage unconsummated. Helena returns sorrowfully to Rousillon, and finds there a letter from her husband to the effect that when she gets his ring upon her finger and shows him a child begotten of his body, then he will acknowledge her as his wife. She undertakes to outwit him and reclaim him, and leaving Rousillon on pretense of a pilgrimage she has it reported that she is dead. In reality she goes to Italy and becomes Bertram's wife in fact, and not mere name, by the substitution of herself for the pretty Diana with whom he has an assignation arranged. There is an entanglement of petty accidents and incidents connected with an exchange of rings, etc. But finally Helena makes good before the king her claim of having fulfilled Bertram's conditions; and she having vowed obedience, he takes her to his heart. Shakespeare has followed his original closely, but the Countess, the Clown Lafen, and Parolles are creations of his own.

Alluvion, the legal designation of land gained from the water by gradual changes in the shore line. In English law the form of the word generally used is alluvion, and in Scotch law alluvio. In both of these the enactment is, that if an «eyott,» or little island, arise in a river midway between the two banks, it belongs in common to the proprietors on the opposite banks; but if it arise nearer one side it then belongs to the proprietor whose lands it there adjoins. If a sudden inundation cut off part of a proprietor's land, or transfer the materials to that of another, he shall be recompensed by obtaining what the river has deposited in another place; but if the process be a gradual one there is no redress. In the United States the proprietor of the bank increased by alluvion may lawfully claim the addition, this being regarded as the equivalent for the loss he may sustain from the encroachment of the water upon his land. Sea-weed which is thrown upon a beach, as partaking of the nature of alluvion, belongs to the owner of the beach. 2 Johns. N. Y. 322. But sea-weed below low-water mark on the bed of a navigable river belongs to the public. 9 Conn. 38. See ACCRETION; AVULSION.

Alluvium, a word formerly applied to the gravel, mud, sand, etc., deposited by water subsequently to the Noachian deluge. It was opposed to diluvium, supposed to be laid down by the deluge itself, or, in the opinion of others, by some great wave or series of waves originated by the sudden upheaval of large tracts of land or some other potent causes, different from the comparatively tranquil action of water which goes on day by day.

Now alluvium is especially employed to designate the transported matter laid down by fresh water during the Pleistocene and Recent periods. Thus it indicates partly a process of mechanical operation and partly a date or period. It should not be forgotten that the former has gone on through all bygone geological ages and has not been confined to any one time. Many of the hardest and most compact rocks were once loosely cohering débris laid down by water. The most typical example of alluvium may be seen in the deltas of the Nile, Ganges, Mississippi, and many other rivers. Some rivers have alluviums of different ages on the slopes down into their valleys. The more modern of these belong to the Recent period, as do the organic or other remains which they contain, while the older (as those of the Somme, Thames, Ouse, etc.), which are of Pleistocene age, enclose more or less rudely chipped flint implements, with the remains of mammals either locally or everywhere extinct. Though in many cases it is possible clearly to separate alluviums of different ages, yet the tendency of each new one is to tear up, redistribute, and confound all its predecessors.

Volcanic alluvium is sand, ashes, etc., which, after being emitted from a volcano, come under the action of water and are by it redeposited, as was the case with the materials which entered and filled the interior of houses at Pompeii.

Marine alluvium is alluvium produced by inundations of the sea, such as those which have from time to time overflowed the eastern coast of India.

Al'lyl, in chemistry, the radical CH_2:CH.CH_2, or C_3H_5. (The isomeric radical CH_3.CH:CH is called propenyl.) Allyl forms many compounds, of which the most important is perhaps allyl alcohol, C_3H_5.OH, which is produced when glycerin is distilled with oxalic acid.

Al'lyn, Robert, American clergyman and educator: b. Ledyard, Conn., 25 Jan. 1817; d. 7 Jan. 1894. Educated at Wesleyan University, Middletown, Conn., he entered the Methodist Episcopal ministry. He was appointed commissioner of public instruction for Rhode Island in 1854, and served three terms in the legislature of that State. He was president of the Wesleyan Female College, Cincinnati, Ohio, 1859–63, and of McKendree College, Illinois, 1863–73.

Al-Mamun, mä-mōn', a caliph of the Abasside dynasty, son of Harun al-Rashid: b. 786; d. 833. Under him Bagdad became a great centre of art and science.

Alma, Mich., a town in Gratiot County, 38 m. W. of Saginaw, on Pine River, and Ann Arbor and Père Marquette R.R.'s; founded 1854; inc. 1872. It manufactures flour, lumber, and beet sugar; has water works and electric lighting. It contains Alma College (q.v.), and Alma Sanitarium, widely reputed. It has one-year mayoralty and a council of six. Pop. (1900) 2,047.

Alma, a river in the Crimea, rising at the foot of the Tchadir Dagh, and flowing W. into the Bay of Kalamita, about half way between Eupatoria and Sebastopol. On the steep banks of the stream, through the channel of which the British troops waded amid a shower of bullets, a brilliant victory was won 20 Sept. 1854, by the allied armies of England, France, and Turkey, led by Lord Raglan and Marshal St. Arnaud, over the Russian army commanded by Prince Menschikoff. It was the first battle of the Crimean war.

Almack's, the name formerly given to certain assembly-rooms in King Street, St. James's, London, derived from Almack, a tavern-keeper, by whom they were built, and whose real name is said to have been M'Call, and transformed into Almack by reversing the syllables. The premises are now known as «Willis's Rooms.» First opened 20 Feb. 1765, they soon became famous for the extreme exclusiveness displayed by the lady patronesses in regard to the admission of applicants for tickets. These fair arbiters composed a board of six, which held its sittings every Monday evening during the London season, and issued those fiats which were supposed to affect so conclusively the claims of the received or rejected applicant, as the case might be, to occupy the upper circles in the fashionable world. To have danced at Almack's became almost proverbial as indicative of exalted social position. The name was also given to a gambling club established by the same Almack in 1763, to which such men as Charles James Fox, William Pitt, and Gibbon belonged.

Alma College, a co-educational institution in Alma, Mich., organized 1887 under Presbyterian control; reported in 1899: Professors and instructors, 20; students, 254; volumes in library, 17,000; grounds and buildings valued at $60,000; productive funds, $220,000; income $155,000; graduates, 213.

Almada, a town of Portugal, in the province of Estremadura, on the left bank of the estuary of the Tagus, opposite Lisbon. It is built upon a height, in a well-cultivated country, and has long been celebrated for its figs. It has a strong castle on a rock, a hospital for British seamen, a Latin school, several depots for wine, and a mineral spring. Pop. 7,000.

Almaden, Cal., a town in Santa Clara County, noted for its mines of mercury and its mineral springs. It was named after the Spanish town mentioned below on account of its four quicksilver mines, the New Almaden, Providence, Enriquita, and Guadelupe. Large quantities of mercury have been distilled from the ore (cinnabar), and the existence of this deposit has been of immense benefit to the Pacific States. Pop (1900) 1,599.

Almaden, or **Almaden del Azogue** (mine of quicksilver), a town in Spain 50 m. S.W. of the town of Ciudad-Real in the province of the same name. It is widely known for its rich quicksilver mines which have been worked for centuries, and in which some 4,000 miners are employed. Since 1645 the mines have been the property of the Crown. The town contains a ruined castle of the Moorish period and a school of mines. Pop. (1900) 7,459.

Almagest. The usual appellation of the 'Syntaxis' of Ptolemy, derived from an Arabic term signifying "the greatest." This celebrated work was written about the middle of the 2d century of our era, and comprises an exposition of the ancient system of astronomy, so elaborate and thorough as to have made it a standard for 13 centuries. It contains the most ancient known catalogue of the stars, with observations of the motion of the planets, and determinations of their periods. Several editions, one in Greek and others in Latin, appeared in Europe between 1500 and 1700. The most recent accessible edition is that of the Abbe Halma, which is in Greek and French (2 Vols. Paris 1814–15).

Almagro, Diego, one of the companions of Pizarro in the conquest of Peru, was a foundling, and the exact date of his birth is not known; d. 1538. He engaged with Pizarro and Fernando de Lugue in the long and arduous expedition in which they made the discovery of Peru (1524–27), took part in the conquest of the country and the treacherous murder of Atahualpa (1533), and after frequent disputes with Pizarro about their respective shares in their conquests he led an expedition against Chile, of which he was appointed governor. Having failed to conquer his new province he returned to find Cuzco in possession of the Indians, who had expelled Pizarro. He reconquered it and made himself governor, but, Pizarro returning, a struggle took place between the two parties in which Almagro was finally overcome, taken prisoner, strangled, and afterward beheaded. He was avenged by his son, who raised an insurrection in which Pizarro was assassinated in 1541. The younger Almagro was put to death in 1542 by De Castro, the new viceroy of Peru. Almagro showed himself, like most of the Spaniards engaged in the conquest of the New World, capable of enduring great privations with heroic constancy, and of effecting wonderful achievements by undaunted valor, but cruel, rapacious, and unscrupulous in success.

Almagro, a town in Spain in the province of Ciudad-Real, 12 m. from the city of Ciudad-Real, in the midst of an elevated sterile plain. Its streets are wide and well paved and there is a large open public square. Lace is made here to a considerable extent, as well as soap, brandy, and coarse pottery. It is best known, however, as the centre of Valdepeñas district. Pop. (1900) 8,015.

Almalee, a town of Asiatic Turkey, on the river Myra, 25 m. from its mouth, and 50 m. W.S.W. of Adalia. It is beautifully situated in a kind of natural amphitheatre enclosed by lofty mountains. It has thriving manufactures and a considerable trade. Pop. 12,000.

Alma Mater, a term familiarly applied by those who have attended a university to the particular university they have attended. The adjective *almus* in Latin means cherishing, fostering, dear.

Almanac, a table or calendar, in which are set down the revolutions of the seasons, the rising and setting of the sun, the phases of the moon, the most remarkable conjunctions, positions, and phenomena of the heavenly bodies, for every month and day of the year; also the several fasts and feasts to be observed in the Church and State, etc. The history of the almanac, and even the etymology of the word, are involved in considerable obscurity. It is generally derived from the Arabic article *al*, and the verb *manach*, to count. The modern almanac answers to the *fasti* of the ancient Romans. Almanacs became generally used in Europe within a short time after the invention of printing; and they were very early remarkable, as some are now in England, for the mixture of truth and falsehood which they contained. In 1579 their effects in France were found so mischievous, from the pretended prophecies which they published, that an edict was promulgated by Henry III. forbidding any predictions to be inserted in them relating to civil affairs, whether those of the State or of private persons. No such law was ever enacted in England. It is singular that the earliest English almanacs were printed in Holland on small folio sheets; and these have occasionally been preserved from having been pasted within the covers of old books. In the reign of James I. letters patent were granted to the two universities and the Stationers' Company for an exclusive right of printing almanacs. These, in 1775, were declared to be illegal. During the civil wars of Charles I., and thence onward, English almanacs were conspicuous for the unblushing boldness of their astrological predictions and their determined perpetuation of popular errors. The Stationers' Company, who had managed to retain a monopoly notwithstanding the invalidity of the letters patent in their favor, were guided merely by commercial principles in supplying the market, and accordingly adapted their almanacs to the taste of the public, which, on one occasion, when the trial was actually made, refused to purchase them without the predictions. Gradually, however, a better taste began to prevail, and in 1828 the Society for the Diffusion of Useful Knowledge had the merit of

taking the lead in the production of an unexceptionable almanac in Great Britain. The example thus set has been almost universally adopted. Almanacs, from their periodical character and the frequency with which they are referred to, are now more and more used as vehicles for conveying statistical information. Regiomontanus was the first person in Europe who prepared almanacs in their present form, without the predictions, which were in all probability introduced into Europe from the Persians. Once they were almost entirely filled with subjects of a religious character. At another time they overflowed with astrological calculations and predictions. In the time of Napoleon an almanac was published in France, in which, to every day, an achievement of the emperor, or something else relating to him, was added. Almanacs, in the petty principalities of Germany, exhibit the endless genealogical tables of the princes. Some almanacs in modern Greek, printed at Venice, where formerly all books in this language were published, are quite full of astrological superstition and matters relating to the Greek Church. A modern Persian almanac contains a list of fortunate days for certain purposes; as, for example, to buy, to sell, to take medicine, to marry, etc.; and predictions of events, as earthquakes, storms, political affairs, etc. One of the most curious almanacs is an Italian one, exhibiting Italian vivacity in a striking manner. To the entry 30 July is added, *Sudano ancora le ossa!* (Even the bones sweat); to 11 August, *Oh! che noia!* (Oh! how distressing!); to 12 July, *Cascano le braccia* (The arms fall); to 2 January, *Stivali e ombrello!* (Leggings and umbrellas!) In Germany, *almanach* is the name given to annuals like those which used to appear in England and the United States under the names of 'Souvenir,' 'Forget-me-not,' etc. In France a work once appeared annually, entitled 'Almanach des Gourmands,' which was conducted with much spirit and is in high repute among epicures. Some of the almanacs that are regularly published every year are extremely useful, and are indeed almost indispensable to men engaged in official, mercantile, literary, or professional business. Such in Great Britain are 'Oliver & Boyd's Edinburgh Almanac,' 'Thom's Official Directory,' and the 'British Almanac,' with its 'Companion.' 'Whitaker's Almanac' is also known as a very comprehensive and valuable compendium. The 'Almanach de Gotha,' which has appeared at Gotha since 1764, contains in small bulk a wonderful quantity of information regarding the reigning families and governments, the finances, commerce, population, etc., of the different States throughout the world. It is published both in a French and in a German edition. 'The Nautical Almanac' is an important work published annually by the British government, two or three years in advance, in which is contained much useful astronomical matter, more especially the distances of the moon from the sun, and from certain fixed stars, for every three hours of mean time, adapted to the meridian of the Royal Observatory, Greenwich. By comparing these with the distances carefully observed at sea the mariner may with comparative ease infer his longitude with sufficient accuracy, in case he has no chronometer for keeping Greenwich time. This almanac was commenced in 1767 by Dr. Maskelyne, astronomer royal. The French 'Connaissance des Temps' is published with the same views as the English 'Nautical Almanac' and nearly on the same plan. It commenced in 1679. Of a similar character is the 'Astronomisches Jahrbuch,' published at Berlin. The 'American Ephemeris and Nautical Almanac' is issued annually since 1855 by the United States government.

The first American almanac was that of William Pierce of Cambridge, published in 1639. The most famous of American almanacs was 'Poor Richard's' published in Philadelphia by Benjamin Franklin under the pseudonym of "Richard Saunders." This almanac was probably imitated from that of Thomas, of Dedham, Mass., which was kept for a good many years and contains many pleasant and witty verses, jests, and sayings. The information printed in these almanacs seems to have been the only means of carrying news to the more distant parts of the country. 'The American Almanac' appeared between 1830–61, and a second publication under the same name was edited for several years by Ainsworth R. Spofford. Several of the largest newspapers in the United States now issue almanacs which are marvels of condensed information. See CALENDAR.

Al'mandite, or **Al'mandine,** a variety of the garnet (q.v.).

Alman'sa, a town of southeastern Spain (Murcia), near which was fought (25 April 1707) a decisive battle in the War of the Spanish Succession, when the French, under the Duke of Berwick, defeated the Anglo-Spanish army under the Earl of Galway. Pop. 8,000.

Alman'zur, or **Almansur,** a caliph of the Abasside dynasty, reigning 754–775. He was cruel and treacherous and a persecutor of the Christians, but a patron of learning.

Alma-Tadema, Laurenz, Dutch painter: b. West Friesland, Holland, 8 Jan. 1836. He was educated at the Antwerp Academy of Fine Arts under the artist Leys and obtained a medal at the Paris Salon of 1864 and another at the Paris Exposition of 1867. He went to England to live in 1870, exhibiting at the Royal Academy that same year 'Un Amateur Romain,' and 'Un Jonglier,' which attracted immediate attention. He became a member of the Royal Academy in 1879, and in 1899 was knighted. His especial field is the portrayal of Greek and Roman life, and all his work is marked by the most careful attention to archæological details. He is scholarly in execution, his coloring accurate, and his artistic feeling rarely at fault, but while his canvasses attract the eye and delight the intellect they seldom touch the heart. Among his more noted pictures are 'The Vintage Festival'; 'The Four Seasons'; 'Antony and Cleopatra'; 'The Women of Amphissa'; 'An Audience at Agrippa's'; and 'A Reading from Homer.' See Zimmern's 'L. Alma-Tadema: His Life and Work' (1886).

Alma-Tadema, (Miss) Laurence, English novelist: b. in England. She is the second daughter of the noted artist, L. Alma-Tadema (q.v.) and has published 'Love's Martyr'; 'The Wings of Icarus'; 'The Crucifix,' a collection of tales; 'Realms of Unknown Kings,' a book of verse; 'The Fate Spinner' (1900); 'The Unseen Helmsman' (1901).

Almond, the tree and nut of *Amygdalus communis* of the natural order *Rosaceæ,* supposedly a native of the Mediterranean region and of southwestern Asia, but so long in cultivation that its origin is a matter of conjecture. In habit of growth the tree, which reaches a height of 20 or 30 feet, is like the peach, with which some botanists surmise that it was formerly identical, but from which, by selection, it has become differentiated, the hard, inedible pulp of its fruit (a drupe), which splits at maturity and and exposes the pit or "almond" of commerce, being replaced by the edible fleshy part prized in the peach. Varieties of almonds are classed as bitter or sweet. The former, little grown outside the Mediterranean region, furnish prussic acid and oil of bitter almonds used in perfumery and culinary preparations; the latter, grown extensively in California and southern Europe and in similar climates, furnish one of the most agreeable of nut fruits. The sweet almonds are divided into hard- and soft-shelled varieties, the former little grown, the latter extensively. Some specially thin-shelled sorts are known as paper-shells. The kernels, particularly of sweet almonds, are rich in a mild fixed oil which is expressed for medicinal and other purposes, but the nuts are chiefly used for dessert, either directly or in some prepared form, such as confectionery.

The almond succeeds best upon light, thoroughly drained soil so situated that early frosts, which destroy the fertility of the blossoms, need not be feared. The trees, which are generally propagated by budding the desired varieties upon bitter almond seedlings, are set about 25 feet apart, different varieties that blossom simultaneously being planted in each other's proximity to ensure cross-pollenation, self-sterility being characteristic of many varieties. If trees are properly trained during their first three or four years they demand little severe pruning afterward. Cultivation does not differ materially from that of other tree-fruits. In California the nuts are harvested from August to October, dried for several days, and if discolored, as is often the case where the air is very humid, they are lightly sprayed with water and then treated with sulphur fumes to bleach the shells somewhat. Nuts that are too badly discolored to respond to this treatment are cracked by machinery and the kernels sold largely to confectioners. Because frost and self-sterility have been often overlooked, almond-growing in California has been remarkable for failures; many orchards have been cut down for firewood. But when and where conditions are favorable the crop is a profitable one. In 1897 218 carloads were shipped from California; in 1898 only 25. Planting in that State is practically at a standstill. Attention has been drawn to parts of Arizona and New Mexico as probably adapted to the almond, and some orchards have been planted. About $1,000,000 worth of almonds are imported annually. The almond is attacked by a vegetable fungus which appears first as a yellow rust on the leaves. This often leaves the tree bare of foliage as early as 15 July. Spraying is the only remedy. See FUNGICIDES.

As an ornamental tree the almond, like the peach, is often planted even in localities unfavorable to fruit-production. But its relative, the dwarf almond (*Amygdalus nana*), a native of southern Russia, is hardy and is recommended as an ornamental shrub by nurserymen for northern climates.

Aloë, a genus of succulent-leaved plants of the natural order *Liliaceæ,* natives of warm countries. The numerous species range in height from a few inches to 25 feet or more. Some are valued for their fibre, which is used for cord-, net-, and fabric-making: others for the medicinal qualities ascribed to them. Chief among the latter are several arborescent species, *Aloë succotrina, A. spicata, A. purpurascens,* and *A. arborescens,* from which Cape aloes is mainly derived, and *Aloë vera,* an East and West Indian species found also on certain islands of the Mediterranean Sea and in Italy, which yields Barbadoes or hepatic aloes. *Aloë Perryi* furnishes Zanzibar or Socotrina aloes, also a transparent pigment valued in miniature-painting, and a rich violet dye.

Aloes, the inspissated juice of the leaves of a number of species of *Aloë,* a genus of the lily family of over 100 species, widely distributed in warm arid regions. The leaves are long, thick, and succulent, and the juice that yields aloes is thin and flows readily from the cut leaf. This is then thickened (inspissated) by natural or by artificial drying, and there results a yellow to brownish to blackish, or greenish, mass of a tarry, waxy, or glassy consistency. The aloes that is used in the United States is either Barbadoes aloes, from *Aloë vera,* or Socotrina aloes, from *Aloë Perryi.*

As a medicine aloes has been used for centuries. It is a powerful cathartic, acting particularly on the large intestine, its active principle being termed *aloin.* Its action is extremely variable, and in large doses it has been known to induce abortion. See CATHARTICS.

Aloes Wood (sometimes called also eagle wood, calambac, paradise wood, or agallochum), the inner part of *Aquilaria ovata* and *Aloes agallochum,* trees of the order *Aquilariaceæ,* natives of the tropical parts of Asia, and supposed to be the aloes or lignaloes of the Bible. They are large, spreading trees. Aloes wood contains a dark-colored, fragrant, resinous substance, and is much prized in the East as a medicine and for the pleasant odor it diffuses in burning.

Alopecia, a partial or complete loss of hair in large quantities. This is due to a number of causes and frequently leads to baldness (q.v.). Alopecia is of two main kinds: primary or secondary. In primary alopecia there may be (1) a congenital lack of hair (this is rare); (2) senile alopecia, due to the advent of old age; (3) premature baldness, this may be a natural product, or it may be the result of a chronic seborrhea, or dandruff (q.v.).

Aloysius Gonzaga, Saint: b. in Lombardy 1568. At the age of 17 he transferred his inheritance and right of succession to his brother Rudolph and immediately set out for Rome. Here he entered the novitiate of the Society of Jesus, and shortly after began his studies in the Roman College. While nursing the victims of a contagion then ravaging the city he contracted the disease, which carried him off in his 25th year. His brief career was characterized by such extraordinary virtue that he was canonized a saint by Pope Benedict XIII. in 1726, and is now recognized by the Catholic Church as the Patron of Young Students. His feast day is celebrated June 21.

Alpaca, or **Paco** (Ar. *al*, the; Peruv. *paca*), a semi-domesticated animal (*Lama pacos*), native to the Andes and valued for its wool. It is a cameloid mammal, closely allied to three others of the same region, the vicuña, the llama, and the guanaco; but it much resembles a sheep, except in the length and erect carriage of its head. The natural growth of its thick woolly hair would be about two feet, but it is clipped, the annual growth being about eight inches. In color the wool varies from pale yellowish brown or gray to black; its fibre is straighter than that of sheep wool, and very fine, glossy, and elastic. The animal is now seldom seen in an entirely wild state. See LLAMA.

Alp-Arslan ("strong lion"), the greatest ruler of the Seljuk Turks: b. Turkestan, 1028; d. Berzern 1072. He succeeded his uncle Togrul 1063, consolidated his realm into one kingdom, and then proceeded to a career of conquest interrupted only by his death. He conquered central Asia to the Oxus; and invading Armenia and Georgia, in August 1071, he overthrew and captured the Emperor Romanus IV. (Diogenes) in a bloody battle near Malaskerd, between Van and Erzerum, and only released him on payment of a vast ransom. He was assassinated while invading Turkestan and was buried at Merv.

Alpena, Mich., a city and the county-seat of Alpena County, 110 miles north of Bay City; on the west side of Lake Huron, at the head of Thunder Bay, on the Detroit and Mackinaw Ry. It is divided in two by Thunder Bay River.

Industries, etc.— There are extensive manufactures of paper from wood-pulp, and of cement from limestone and clay. Further establishments include two large tanneries, large extract works (hemlock) for export trade, two foundries and machine shops, five saw-mills, 20 shingle-mills, two veneer-mills, a woolen-mill, two flour-mills, three large sash and blind factories, two large excelsior-mills, quarries, and two stave and heading factories. The harbor facilities are excellent.

Public Institutions, Buildings, etc.— There is a public library and a park system. Lutherans have three church edifices; Catholics, three; Methodists, two; Congregationalists, one; Presbyterians, one; Episcopalians, one; Baptists, one; Seventh Day Adventists, one; Jews, one; Free Methodists, one; Church of Latter Day Saints, one; and Non-Sectarians, one. The three banks have a combined capital of $250,000, with an annual business of $2,500,000.

History and Government.—Alpena was settled in 1835, and was incorporated in 1871. It is governed under a revised charter of 1897 by a mayor, biennially elected, and a council of 12 members, elected annually. The mayor has no power of appointment. Pop. (1904) 12,400.

MICHAEL O'BRIEN.

Alphabet (from *alpha* and *beta*, the first two letters of the Greek alphabet), the ordinary series of the letters or syllables (in syllabic alphabets) of a language. For an account of what is known or conjectured of the origin of alphabetic and other systems of writing, see WRITING. The English alphabet, like the most of those of modern Europe, is derived directly from the Latin, but owes its ultimate origin to the Phœnician, which gave birth also to the ancient Greek, the Etruscan, the Gothic, etc. According to tradition the Phœnician Cadmus introduced writing into Greece, the letters first used being the same as the Phœnician, but afterward undergoing changes both in sound and form. It would appear that the Phœnicians themselves borrowed their alphabet from the hieratic alphabet of Egypt, whence also the Hebrews may have obtained theirs during their long stay in that country, though it is more probable that like others they were content to receive it at second-hand from the Phœnicians. The Hebrew alphabet now employed is not the original one, but has an Aramaic origin, having been adopted some time after the Captivity. The Hebrew alphabet proper, as we find it on ancient coins, is evidently the same as that of the Phœnician inscriptions. The names of the letters in Phœnician and Hebrew must have been almost the same, for the Greek names, which, with the letters, were borrowed from the former, differ little from the Hebrew. By means of the names we may trace the process through which the Egyptian characters were transformed into letters by the Phœnicians. Some Egyptian character would, by its form, recall the idea of a house, as for example, in the Phœnician or Hebrew *beth*. This character would subsequently come to be used wherever the articulation *b* occurred, whether in the beginning, middle, or end of a word. Its form might be afterward simplified, or even completely modified, but the name would remain, as *beth* still continues the Hebrew name for *b*, and *beta* the Greek. Our letter *m*, in Hebrew called *mim*, water, has still a considerable resemblance to the zigzag wavy line chosen to represent water, as in the zodiacal symbol for *Aquarius*. The letter *o*, of which the Hebrew name means eye, was originally intended to represent that organ. From the ancient Greek alphabet are generally derived in a direct line the ordinary Greek alphabet, the Latin, and the Etruscan, though the last may have been directly derived from the Phœnician. The later Greek alphabet furnished elements for the Coptic, the Gothic, and the old Slavic alphabets. The Latin characters are now employed by many nations, such as the Italian, the French, the Spanish, the Portuguese, the English, the Dutch, the German, the Hungarian, the Polish, etc., each having introduced such modifications or additions as are necessary to express the sound of the language peculiar to it. The Greek alphabet originally possessed only 16 letters, though the Phœnician had 22. These were the five vowels, α, ε, ι, ο, υ, (*a, e, i, o, u*, as in French), and the 11 consonants, β, γ, δ, κ, λ, μ, ν, π, ρ, σ, τ (*b, g, d, k, l, m, n, p, r, s, t*). According to one tradition, Palamedes, a contemporary of the Trojan war, invented ξ (*x*) and the three aspirates θ, φ, χ (*th, ph, ch* guttural). To Simonides was attributed the invention of the double consonants ζ and ψ (*ds* or *z*, and *ps*) and the two long vowels η and ω (*ē* and *ō*), which completed the Greek alphabet of 24 letters as still used. Besides these, there was anciently the *digamma*, a character corresponding pretty nearly to *v*, which afterward slipped out of the Greek alphabet; and the character ' representing an aspirate at the beginning of words. The original Latin alphabet, as it is found in the oldest inscriptions, consisted of 21 letters; namely, the vowels *a, e, i, o*, and *u* (*v*), and the consonants *b, c, d, f, z, h, k, l, m, n, p,*

q, r, s, t, x. *Z* slipped out at an early period, and *g* took its place. To these we might also add the characters *æ* and *œ*, representing the Greek dipthongs *οι* and *αι*. The letters *ι* and *u*, it must be remarked, had a double force, that of a vowel and that of a consonant. In the latter case they were, after the introduction of printing, changed frequently into *j* and *v*. The *i* consonant, as in *iuventus* (youth), had a sound resembling that of *y* in English or *j* in German; *u*, consonant, as in *uespa* (*vespa*), a wasp, had a sound much like the English *w* — *wespa*. (At least this opinion appears best supported by the evidence.) No genuine Latin word contains either *y* or *z*, these being used in foreign (chiefly Greek) words adopted into the language; and *k* is found in classical Latin only in *Kalendæ*. While the alphabets of the west of Europe are derived from the Latin, the Russian and other Slavonic alphabets of the East come from the Greek. The modern Russian, consisting of 35 letters, is a modification and simplification of the ancient Cyrillic alphabet, invented by Cyril in the 9th century in order to translate the Gospels into the language of the Slavs of Bulgaria and Moravia. It was formed of Greek letters, together with some borrowed from the Armenian and Coptic alphabets, themselves descended from the Greek. The Anglo-Saxon alphabet (see ANGLO-SAXONS) had two letters for the two sounds of *th*, which appear to have come from the Greek through the Mœso-Gothic, and which were unfortunately not retained in later English. It wanted the letters *j, k, q, v, z*, but it had the sound *æ*. The German alphabet consists of the same letters as our own, the common German characters being mere modifications of the Roman, but the sounds of some of them are different. Anciently certain characters called Runic (q.v.) were made use of in Germany and Scandinavia, to which some would attribute an origin independent of the Greek and Latin alphabets. Among Asiatic alphabets the Arabian has played a part exactly analogous to that of the Latin in Europe, the conquests of Mohammedanism having imposed it on the Persian, an Aryan language; the Turkish, a Tatar language; the Hindustani, also an Aryan language; and even the Malay. It consists of 28 letters, and appears to derive its origin from the Sinaitic alphabet, employed during the first centuries of the Christian era, and found in inscriptions in the Sinaitic peninsula, at Petra, in the Hauran, etc. The Sanskrit or Devanagari alphabet is one of the most remarkable alphabets of the world. As now used it has 14 characters for the vowels and diphthongs, and 33 for the consonants, besides two other symbols. The vowel *a* short is to be understood after every consonant, unless excluded by another vowel immediately attached to the consonant. (See SANSKRIT; also articles on the various languages and letters.) Our alphabet is by no means a perfect instrument for what it has to perform, but is both defective and redundant. It is estimated that there are 42 sounds in the language, and only 26 letters to represent them. *A*, to begin with, has to do duty for at least four different sounds, as in *far, fat, fall*, and *fame; o* has three sounds, as *not, note*, and *move; e* has a long sound and a short, as in *mete* and *met*. *C* is a useless letter altogether, since it has always either the sound of *s* or of *k*. Others of the consonants encroach upon each other's provinces; *g*, for example, sounds sometimes like *j*, as in *digest; f* sounds *v* in *of; s* sometimes usurps the sound of *z*, as in *raisin*, sometimes that of *zh* or *sh*, as in *pleasure*.

Alphonsine Tables. See ALFONSO X.

Alphonsus dei Liguori, Saint: b. Naples of noble parents at the end of the 17th century. At the age of 16 he took his degree of Doctor in Civil and Canon Law in the University of Naples and immediately entered the legal profession. This he soon abandoned in order to become a priest and to dedicate his life to the service of the poor in the villages of southern Italy. To assist him in these labors of teaching the poor peasants, he founded the Congregation of the Holy Redeemer, whose members are commonly known to-day in the United States as "Redemptorists." He was made bishop of Saint Agatha by Clement XIII. After 25 years of fruitful labor in this field, he returned to his monastery at Nocera, where he died in 1787. His virtues and learning have made him one of the best known saints in the Catholic Church. He was canonized in 1839 by Gregory XVI., and in 1871 was proclaimed by Pius IX. a Doctor of the Universal Church. His writings deal chiefly with moral theology in theory and practice. His feast is celebrated on 2 August.

Bibliography.—The first authoritative work on Saint Alphonsus was written by one of his scholars, P. Tannoiaand, and is entitled 'Vita ed Instituto del Venerabile Servo di Dio' (3 vols., Naples 1802). In French, an exhaustive work in 4 vols. by Cardinal Villecourt, 'Vie et institut de Saint Alphonse de Liguori' (1863); in English, vid. Butler's 'Lives of the Saints,' and 'Life' by Bishop Mullock.

Alpine Clubs, organizations for the exploration and study of mountains. The original club is the famous Alpine Club of England, organized in 1858, which publishes the 'Alpine Journal.' The first American Alpine Club was organized in 1873. There are in the United States the "Mazamas" and Sierra clubs on the Pacific coast, and the Appalachian Club on the Atlantic. See MOUNTAIN CLIMBING.

Alpine Plants, plants indigenous to high altitudes. The most striking features common to them all are adaptations to rigorous climate such as the dwarfing of the stems of trees and shrubs, but not of roots or flowers, which may even be increased in size over similar plants grown in milder places; gnarled and crooked habit; horizontal or creeping rather than upright growth (the height of the taller species indicating the approximate depth of snow); and the development of structures that tend to check evaporation. Of these last a thickened epidermis, as in conifers, and epidermal hairs, as in edelweiss, are the most striking.

Alps, the most remarkable and interesting system of mountains in Europe. It covers a great part of northern Italy, several departments of France, nearly the whole of Switzerland, and a large part of Austria, while its extensive ramifications in Italy, Germany, Turkey, with its principalities, and Greece, connect it with nearly all the mountain systems of Europe. The name is derived from the Celtic *alb*, which by some is made to signify white, by others height. In the immediate neighborhood of the


EGYPTIAN
PHŒNICIAN
GREEK
GREEK NAMES
LATIN
HEBREW
HEBREW NAMES
1 Alpha Aleph
2 Beta Beth
3 Gamma Gimel
4 Delta Daleth
5 Epsilon He
6 (Digamma) Vau
7 Zeta Zain
8 Eta Cheth
9 Theta Teth
10 Iota Iod
11 Kappa Caph
12 Lambda Lamed
13 Mu Mem
14 Nu Nun
15 Xi Samech
16 Omicron Ain
17 Pi Pe
18 Tzade
19 Koph
20 Rho Resh
21 Sigma Shin
22 Tau Tau
I II III IV V VI VII VIII IX X XI

mountains *alp* has a peculiar meaning, and signifies one of the high pastures for which the Alps are distinguished. This great congeries of mountains may be said to be included between lat. 44° and 48° N.; and lon. 5° and 18° E. The culminating peak of the whole system is Mont Blanc, 15,781 feet high, though the true centre is St. Gothard, or rather the mountains between the sources of the Rhone and the Inn, and the Swiss cantons Valais, Bern, Uri, and Grisons on the north; and canton Tessin, and Lombardy and Sardinia on the south. It is a curious fact that its great central mass is nearly equidistant from the pole and from the equator. From its slopes flow, either directly or by affluents, the great rivers of central Europe, the Danube, Rhine, Rhone, and Po. Round the northern frontier of Italy the Alps form a remarkable barrier, shutting it off at all points from the mainland of Europe, so that, except in the valley of the Adige, where a remarkable break occurs in the chain, or at the opposite extremity at Nice, it can only be approached from France, Germany, or Switzerland, through high and difficult passes. Accordingly nearly all the great passes of the Alps are connected with roads from the northern kingdoms into Italy.

As usual with mountain systems of great altitude, the highest peaks of the Alps are reached by a gradual ascent through a succession of outer ranges and elevated intermediate valleys. The total width of the system is therefore always great and can hardly anywhere be measured with precision, opinion varying as to the points at which the outer limits should be fixed. Toward the east, however, the system, while it diminishes in height, becomes more widely extended, some of the transverse valleys extending to 150 miles, while that of the Drave reaches 200. From Bellinzona, in the canton of Tessin, to Altorf, in that of Uri, the distance is 50 miles. The outer range is called by the Italians *Pre-alpi*, by the Germans *Voralpen*. The main chain of the Alps, which commonly determines the watershed of the countries through which it passes, contains some of the highest peaks; but at several points there are extensive ramifications of the system proceeding at various angles from the main chain, and more or less connected with it, and which sometimes exceed in mass and altitude the corresponding parts of the principal chain. Such are the Alps of Dauphiné and Savoy, and the Bernese Alps. The principal valleys of the Alps run mostly in a direction nearly parallel with the principal ranges, and therefore east and west. The transverse valleys are commonly shorter. In the section called the Lepontine Alps, however, long ranges run north and south, forming valleys transverse to the dividing line of the waters, and terminating in the great Italian lakes. The slopes toward the south are more precipitous than toward the north, and as most of the collateral ranges lie to the north of the main chain the great valleys are mostly to be found in the intervals between them. The transverse valleys of the Alps frequently lead up through a narrow gorge to a depression in the main ridge between two adjacent peaks. These are the passes or *cols*, which are found by tracing a stream which descends from the mountains up to its source. The col is usually found to receive the drainage of the neighboring peaks, and when it is of sufficient extent a small lake is generally formed, from which a stream flows down on each side. When the one stream has been traced up to its source the passage across the mountains is completed by following the course of the other. The principal passes, now well known, are more than 50 in number; but there are many others more difficult and dangerous which have never had more than a local reputation.

The common divisions of the Alps have been taken from the Romans, whose acquaintance with the Alps as the northern boundary of Italy was considerable, yet their classification, being formed mostly for practical purposes, was far from complete. Several modern divisions have been added. The Romans were acquainted with many of the best passes, to which from their altitude they gave the name of *Mons*. Before noticing these divisions a glance may be taken at the general direction of the main chain. The most convenient starting-point is on the Mediterranean coast, near Nice. Eastward the chain proceeds along the coast till it forms a junction with the Apennines, which may be considered as one extremity of the system. In the opposite direction it proceeds northwest, and afterward north on the boundaries of France and Italy to Mont Blanc; it then turns northeast and runs generally in this direction to the Gross Glockner, in central Tyrol, between the Drave and the Salza, where it divides into two branches, the more northerly of which proceeds northeast toward Vienna. The southern chain subdivides again, one branch running in a southerly direction, connects itself with the mountains of Dalmatia, and by a southeasterly continuation with the Balkans and the mountains of Greece; the middle branch proceeds toward the Drave and Danube. With these continuations, which lose themselves insensibly in other ranges, the Alps may be considered to terminate.

The Maritime Alps.— The first great division of the Alps extends from their junction with the Apennines to Monte Viso, a distance of about 100 miles. This mountain is the most prominent object from the basin of the Po, wherever the Alps are visible. The division of the Alps from the Apennines has been variously fixed at Col di Tende and Col d'Altare, near Savona. The northern limit of the Maritime Alps is to the south of Monte Viso. The culminating-points are the Aiguille de Chambeyron, 11,155 feet, and the Grand Rioburent, 11,142 feet. The principal pass is the Col di Tende (6,158 feet), which was made practicable for carriages by Napoleon. It leads from Nice to Turin. The road is dreary, but commands a view of the Alps from Col d'Iséran to Monte Viso. There are carriage roads over the Col di San Bernardo and Col di Nava. Numerous tributaries of the Po and the Durance with the Var and other lesser rivers rise in the Maritime Alps.

The Cottian Alps.— Anciently named after a chief of the district, and extending from Monte Viso to Mont Cenis — consist of numerous mountain masses irregularly grouped, the main line running northeast, and the principal ramifications to the west of it. The length is about 60 miles. Modern geographers have distinguished a separate group, divided from the main chain

by the valley of the Durance, which are called the Dauphiné Alps. These contain loftier peaks than the main chain. Principal peaks of the Cottian Alps: Monte Viso, 12,605 ft.; Chardonnet, 12,373; Ciamarella, 12,081; of the Dauphinese Alps: Pic des Écrins, 13,462; La Meije, 13,081; Pelvoux, 12,973. There is a carriage road by Mont Genèvre (6,102 feet) between the valleys of the Durance and the Dora Ripaira, and by the Col de Sestrières (6,335 feet) from Cesanne to Pignerolo. The road by the former, Cesanne to Briançon, was constructed by order of Napoleon. The difficult pass of Col de la Roue, Bardonnèche to Modane, is that supposed to have been traversed by Cæsar in order to attack the Helvetians. The Durance and the Dora Ripaira rise in the Cottian Alps.

The Graian Alps.— From Mont Cenis to Mont Blanc (50 miles long). This group has extensive ramifications in Savoie and Piedmont. The principal peaks are, in the main chain, Aiguille de la Sassière, 12,326 feet; in the Piedmontese group, Grand Paradis, 13,300; in the Savoie group, Grande Casse, 12,780. Mont Cenis (6,765 feet), the most frequented of all the Alpine passes, was crossed by Pepin to attack the Lombards. A carriage road over it was constructed by Napoleon in 1803–10, leading from the valley of the Arc to Turin, and uniting with the road from Mont Genèvre at Susa. A railway now passes through the mountain by a tunnel nearly eight miles long. (See CENIS.) The pass of Little St. Bernard (7,192 feet) lies between the valleys of the Isère and Aosta. It was made practicable for cars by Augustus, but is now only available for mules. It appears to have been the road taken by Hannibal. The Col de Bonhomme (8,195 feet) communicates with the Col de la Seigne (8,327 feet) in the Pennine Alps. They lead by a mule path from Contamines to Courmayeur. The Stura, and Orca, and the Arc and Isère, rise in the Graian Alps.

The Pennine Alps (Celtic, *pen* or *ben*, a hill) is the loftiest range of the whole system, having Mont Blanc at one extremity and Monte Rosa at the other (60 miles). Here also begin the most extensive ramifications of the system, some of the collateral ranges rivaling or exceeding in mass and altitude the main chain. The Alps of Haute Savoie form a northwestern continuation of this range. The northern boundary of the Pennine Alps is the Valais, or upper valley of the Rhone. On the opposite side of this valley, and nearly parallel with the main chain, runs the great range of the Bernese Alps. Here the grandest panoramas of Alpine scenery are exhibited. The great peaks of the two vast ranges are only about 20 miles apart, and between them run transverse ranges presenting innumerable secondary heights. From the Matterhorn (Mont Cervin), between Mont Combin and Monte Rosa, a series of great heights, including the Weisshorn and the Gabelhorn, run to the north. The main range contains Mont Blanc, Monte Rosa, and Mont Cervin, three of the highest peaks in Europe. On the west the Bernese Alps are connected with the Jura range. The principal heights of the Pennine Alps are Mont Blanc, 15,781 feet; Monte Rosa, 15,217; Mischabelhörner (Dom), 14,935; Lyskamm, 14,889; Weisshorn, 14,804; Matterhorn, 14,780. In the Bernese Alps are the Finsteraarhorn, 14,026; Aletschhorn, 13,803; Jungfrau, 13,671. There are bridle passes, the Col de la Seigne, already mentioned, and the Col de Ferret (8,320 feet), on each side of Mont Blanc. The pass of Great St. Bernard is celebrated for its hospice. (See BERNARD, GREAT ST.) It was crossed by Napoleon in 1800, but it is not practicable for carriages. There are several passes, as the Col du Cervin, the Schwarzthor, and the Col du Lys, from 10,000 to 14,000 feet in height. The most easterly pass is the Simplon, 6,595 feet, from Brieg to Domo d'Ossola. It has a carriage road made by Napoleon. This is about 36 miles long and 25 feet wide throughout, and is carried over steep precipices and through six galleries hewn in the rock. The Grande Galerie is 683 feet long. A double railway tunnel, the longest in the world (12½ miles), is being driven through the Simplon. Numerous tributaries of the Rhone rise in the valley between the mountains, and on the Italian side the Dora Baltea, Sesia, and other rivers.

The Lepontine Alps form the continuation of the main chain on the south side of the great valley or depression stretching from Martigny in the Valais to Coire in the Grisons, the western portion of which forms the basin of the Rhone, the eastern that of the Vorderrhein. From this chain branch the northern and eastern extensions of the Swiss Alps beyond the Bernese range, the eastern boundary of which is fixed at the defile of the Devil's Bridge, near Andermatt, crossed by the Reuss. The Lepontine range extends to the Splügen Pass. The line of watershed is generally parallel to the valley of the Vorderrhein; but here, as already noticed, some of the principal ranges run transverse to it, terminating in the great valleys in which lie the lakes Maggiore, Como, etc., fed by numerous tributaries from this and the following division of the Alps. This division forms the great water-parting of the whole system. Within a radius of a few miles from the St. Gothard Pass rise the Rhone, the Aar, the Reuss, the Vorderrhein, the Ticino, the Toccia, and the Maggia. The principal pass is the St. Gothard (6,936 feet), over which pass is a carriage road from Bellinzona to Altorf. Through this mountain mass a railway tunnel more than nine miles long was opened in 1882. The Gries Pass (8,050 feet) conducts from Obergestelen to Formazza. The Bernardin Pass (6,769 feet), constructed by the Swiss government, leads from Coire to Bellinzona. The road from Coire to the Splügen is the same as leads to the Splügen Pass (6,945 feet), through which it proceeds to Lake Como. This route commands the finest views of Swiss scenery in the Grisons. Previous to the construction of the present road by the Austrian government in 1823 it was difficult and dangerous. Marshal MacDonald, who crossed it in 1800, lost a large number of men by avalanches at a gorge in the passage of the Cardinello, which the new road avoids. The carriage road over the Furka Pass from Obergestelen to Andermatt, completed in 1867, affords a fine view of the Schreckhorn and Finsteraarhorn. The peaks here are of less elevation. The highest, Monte Leone, is 11,696 feet; the Piz Valrhein is 11,148 feet, and several are above 10,000. Of the northern ranges Tödi is 11,887; Bifertenstock, 11,237; Scheerhorn, 11,132, and there are many above 10,000.

The Rhætian Alps extend from the Splügen to Dreiherrnspitz, on the borders of Salzburg and Tyrol. The Engadine, or valley of the Inn, divides them into two portions. The chain is also broken by the valley of the Adige. To the south, separated by the valley of the Adda, are the Lombard Alps, while the more northerly continuations embrace the Tyrolese and Bavarian Alps. In the main range are the Piz Bernina, 13,294 feet; Piz Roseg, 12,936; Ortelerspitze, 12,814; in the Lombard Alps, Monte Adamello, 11,832; Presanella, 11,688; and Care Alto, 11,352. The other ranges are inferior in height. Good roads now become more numerous. The Malloya Pass (5,942 feet) leads from Chiavenna, by the valley of the Inn, to Innsbruck, and communicates with the road over the Julier Pass (7,503 feet) to Coire. The Pass of Glurns (4,400 feet), from the valley of the Inn to the Adige, is the lowest pass over the main chain. It joins the road to Milan by the Valtelline, the highest part of which is 9,174 feet. This is a carriage road constructed by the Austrian government for communication with their Lombard dominions. The Brenner Pass (4,588 feet) leads from Verona to Innsbruck. The Brenner is crossed by a railway. The northern ranges are intersected by the Septima, Julier, Albula, and other passes. The Adda, Oglio, Adige, Hinterrhein, Inn, and other rivers, rise in this part of the chain.

Noric Alps.— The main chain of the Alps here divides into different sections, as already mentioned. The northern part of the chain extending to Vienna was anciently called the Noric Alps, while the southern continuations were known as the Carnian and Julian Alps, the names Venetian, Dalmatian, and Pannonic Alps being also in use. The culminating peak of the northern range is the Gross Glockner, 12,405 feet. Farther east the heights are of much less elevation. In Carinthia and Styria two parallel branches called the Styrian Alps enclose the upper valley of the Mur. In this group is the Hafnereck, 10,044 feet. In south Tyrol and Venetia several peaks rise above 10,000 feet. The Carnic Alps run from the frontiers of Tyrol and Venetia to the frontier of Carinthia. They are separated from the northern range by the Gailthal. The height of the southeastern continuations of the Alps rapidly diminishes, and they lose themselves in ranges having nothing in common with the great mountain masses which distinguish the centre of the system. Mount Terglou, near the northwestern extremity of the Julian Alps, has a height of 9,371 feet. The name Dinaric Alps is given to a continuation from Mount Klek through Croatia and along the borders of Dalmatia and Herzegovina.

There are various points of vantage from which extensive views of Alpine scenery are commanded at the expense of a moderate amount of climbing. The Rigi, which can now be ascended by railway, is one of these. There are hotels at the top, 5,905 feet above the level of the sea, and 4,468 above the Lake of Lucerne. A favorite view from hence is to watch the sun rise over the Bernese Alps. The Faulhorn (8,799 feet), southeast of Lake Brienz, commands a near view of the same range. The Becca di Nona (8,415 feet), south of Aosta, gives, according to some authorities, the finest panoramic view to be obtained from any summit of the Alps. From the Gorner Grat (to which there is now a railway from Zermatt), and various points in the valley of Chamonix, particularly the Montanvert, which is visited to see the Mer de Glace, views of various interest are obtained. The most accessible Alpine glaciers are those of Aletsch, Chamonix, and Zermatt.

Climate.— In the lower valleys the mean temperature ranges from 50° to 60°. Half-way up the Alps it averages about 32°— a height which, in the snowy regions, where snow always lies, the average does not attain. But even here the solar radiation produced by the rocks and snow is often so great as to raise the barometer to 120° and even higher. The exhilarating and invigorating nature of the climate in the upper regions of the Alps during summer has been acknowledged by all who have perambulated these romantic scenes. The freshness of the breeze as it comes from the snowy peaks tempered by the rays of a southern sun, enables the traveler, without weariness, to perform distances on foot that at home he would have shrunk from attempting. Notwithstanding, however, the invigorating nature of the climate, the inhabitants of the higher valleys are often afflicted with goitre and cretinism.

Botany and Zoology.— In respect to vegetation the Alps have been divided into six zones. The limits of these depend not on absolute height, but on height modified by exposure and local circumstances. The lowest is the olive zone. This tree flourishes better on sheltered slopes of the mountains than on the plains of northern Italy. The vine, which bears a greater winter cold, distinguishes the second zone. On slopes exposed to the sun it flourishes to a considerable height. The third is the mountainous zone or region. Cereals and deciduous trees form the distinguishing features of its vegetation. The mean temperature about equals that of Great Britain, but the extremes are greater. The fourth region is the sub-Alpine or coniferous. Here are vast forests of pines of various species, which have in many places been inconsiderately cut down, the result being that the valleys have been deprived of shelter and denuded of soil. Most of the Alpine villages are in the two last regions. On the northern slopes pines grow to 6,000, and on the southern slopes to 7,000 feet above the level of the sea. This is also the region of the lower or permanent pastures where the flocks are fed in winter. The fifth is the pasture region, the term *alp* being used in the local sense of high pasture grounds. It extends from the uppermost limit of trees to the region of perpetual snow. The landscape is adorned with numerous shrubs; rhododendrons, junipers, bilberries, and dwarf willows being among the distinctive forms of vegetation. The sixth is the region of perpetual snow. The line of snow appears from a distance to be continuous at a limit which varies, according to seasons and localities, from 8,000 to 9,500 feet, but on approaching this apparently continuous line it is found to be broken up and crossed by patches of brilliant vegetation, the limit of which appears to be want of soil rather than severity of climate. Few flowering plants extend above 10,000 feet, but they have been found as high as 12,000 feet. At this great elevation two

species of quadrupeds may be seen, the bouquetin or wild goat, and the chamois, which delight in heights inaccessible to man. The bouquetin, which has become very rare, scales the most elevated peaks, while the chamois is generally found rather lower, but is never seen in the plains. In summer the high mountain pastures are covered with large flocks of cattle, sheep, and goats, which in winter are removed to a lower and warmer level. The marmot, and white or Alpine hare, inhabit both the snowy and the woody regions. Lower down are found the mole, the wildcat, the fox, the lynx, the bear, and the wolf; but the last two are now extremely rare. The vulture, eagle, and other birds of prey frequent the rugged Alpine rocks, and "the snowy ptarmigan" seeks food and shelter among the diminutive plants that border upon the snow-line. Other kinds of game, including the grouse, woodcock, and partridge, may be found from the upper limit of the woods to the more level and habitable parts below. Several kinds of water-fowl frequent the higher lakes, where excellent trout and other fish are found; but those situated at the greatest elevation are, from their low temperature, entirely destitute of fish.

Geology and Minerals.— The geological structure of the Alps is highly involved, and is far, as yet, from being thoroughly investigated or understood. In general three zones can be distinguished, a central, in which crystalline rocks prevail, and two exterior zones, in which sedimentary rocks predominate. The rocks of the central zone consist of granitic gneiss of various forms, seldom pure granite, gneiss, hornblende, mica slate, and other slates and schists. In the western Alps there are also considerable elevations in the central zone that belong to the Jurassic (Oolite) and Cretaceous formations. From the disposition of the beds, which are broken, tilted, and distorted on a gigantic scale, the Alps appear to have been formed by a succession of disruptions and elevations extending over a very protracted period. The large beds of calcareous rock which overlie the older rocks both to the east and west appear to have been ruptured and rolled back by the upheaval of the central mass. Mining is not carried on to an extent proportionate to the magnitude of the mountain range. Iron and lead, however, are found in considerable abundance, and the Bleiberg (lead mountain) mine, in Carinthia, furnishes the purest lead in Europe. Rock-salt is abundant toward the north of the chain, and the salt-works of Bex in Canton de Vaud, of Hall in Tyrol, of Hallein and of Berchtesgaden in the vicinity of Salzburg, are of note. Mercury exists chiefly in the east part; the richness of the mine of Idria, northwest of Trieste, is well known. Besides those principal products, gold, silver, copper, zinc, alum, and coal are wrought to some extent.

Alsace-Lorraine, äl-säs-lō-rān' (German, *Elsass-Lothringen*), a district occupying the extreme southwest corner of Germany, bounded west by France, east by Baden, and south by Switzerland. Its length from north to south is 123 miles; its breadth varies from 22 to 105 miles; and its area is 5,580 square miles, of which 1,353 belong to Upper Alsace (in the south), 1,844 to Lower Alsace (northeast), and 2,383 to Lorraine (northwest). Pop. (1900) 1,717,451, of whom 76 per cent were Roman Catholics, and more than 80 per cent spoke German — mainly the vernacular Alsatian, a dialect of Alemannian. The most populous districts in their order are Lower Alsace, Lorraine, and Upper Alsace. The French-speaking population is mainly in the larger towns and in Lorraine. The Rhine flows 115 miles north by east, along all the eastern border, and receives, below Strasburg, the Ill from Alsace, 127 miles long. Other rivers are the Moselle, flowing through Lorraine past Metz, and its affluent, the Saar. Along the Rhine is a strip of level country, 9 to 17 miles broad and declining from 800 to 450 feet above sea-level. Westward of this rise the Vosges Mountains, culminating at a height of 4,677 feet; while Lorraine, rather hilly than mountainous, rarely attains 1,300 feet. About 48.5 per cent of the entire area is arable, 11.6 meadow and pasture, and 30.8 under wood. Alsace-Lorraine produces much wine, grain, and tobacco; it is rich in mines, iron and coal; and manufactures iron, cotton, wool, silks, chemicals, glass, and paper. It contains the important cities of Strasburg (pop. 1900, 150,268); Mühlhausen (pop. 1890, 27,538); Metz (pop. 1890, 60,186); Colmar (pop. 1890, 30,411). As a French province, Alsace was divided into the departments of Haut-Rhin and Bas-Rhin. Lorraine fell into the departments of Meuse, Moselle, Meurthe, and Vosges (parts of all which still remain French). The lieutenant-governor (*Statthalter*), representing the imperial government, resides at Strasburg, and is assisted by a ministry of five departments and a council of state.

From the 10th century Alsace-Lorraine formed part of the German empire till a part of it was ceded to France at the Peace of Westphalia (1648), and by the Peace of Ryswick (1697) the cession of the whole was ratified. German never ceased to be the chief language of the people, and all newspapers were, during the whole period of the French possession, printed in both languages. In 1871, after the Franco-Prussian war, Alsace and German Lorraine were, by the Treaty of Frankfort, incorporated in the new German empire. The great mass of the population was strongly against the change, and 160,000 elected to be French, though only 50,000 went into actual exile, refusing to become German subjects. Since the era of the Revolution Alsace in sentiment was wholly French. To France she gave the bravest of her sons — Kellerman, Kléber, and many another hero. Strasburg first heard the 'Marseillaise'; and MM. Erckmann-Chatrian, Lorrainers both, have faithfully represented their countrymen's love of *La Patrie* in the days of the second as of the first Napoleon. Of late it is claimed by the Germans that, through the emigration of the irreconcilables and the immigration of German settlers, the tendency of the old natives to accept the inevitable, and the rising up of a new generation, to whom the French connection is a tradition, the situation has slowly but steadily changed in favor of Germany and the existing firm but fair administration. The irritating passport system, a special grievance not in force elsewhere in Germany, was withdrawn in 1873. On 9 May 1902, Emperor William directed that a bill be laid before the Federal Council abolishing paragraph 10 in the imperial constitution, which imposed practically a dictatorship on the *reichsland* of Alsace-Lorraine.

Alsop, Richard, poet: b. Middletown, Conn., 23 Jan. 1761; d. Flatbush, L. I., 20 Aug. 1815. He studied at Yale, but did not complete his course. He formed the literary group known as the "Hartford Wits," which includes Benjamin Trumbull, Lemuel Hopkins, and Theodore Dwight. Alsop was largely responsible for the 'Echo' (1791–5), a series of travesties and burlesques on current fads and literature (pub. in book form 1807). He wrote 'Monody on the Death of Washington' (1800); the 'Enchanted Lake of the Fairy Morgana' (1808).

Altai (al'tī) **Mountains,** a mountain range of central Asia, extending from the desert of Gobi in a northwesterly direction along the boundary of Mongolia and Sungaria. After passing the Russian frontier it gradually falls off in altitude and merges into the steppes. The rivers of this region are mostly head waters of the Obi and Irtysh. The mountain scenery is generally grand and interesting. The highest summit is Baluka, about 17,500 feet above the sea. The area covered by snow and glaciers is large. The mountains have a severe climate, but agriculture is carried on to some extent in the larger valleys. The inhabitants are chiefly Russians and Kalmuks.

Altaic Languages, a family of languages occupying a portion of northern and eastern Europe, and nearly the whole of northern and central Asia, together with some other regions, and divided into five branches, the Ugrian or Finno-Hungarian, Samoyedic, Turkic, Mongolic, and Tungusic. Also called Ural-Altaic and Turanian.

Altar, the structure on which sacrifices are offered or incense burned as an act of worship. In the Catholic Church, the sacred table on which is offered the Sacrifice of the Mass. The earliest altars were of wood, but Pope Silvester, at the beginning of the 4th century, decreed that the altar should be made of stone, or at least that part of it on which the chalice and host are placed. The ritual of the Catholic Church commands that the altar must be consecrated by a bishop or a mitred abbot who has received the faculties and the relics of a saint to be enclosed in the altar stone, which is placed in the centre of the table of the altar.

Altgeld, John Peter, American politician: b. Germany, Dec. 1847; d. 12 March 1902. Brought to Mansfield, Ohio, in infancy, he received a public-school education; served in the Civil War as a private in the Union army, 1864–65; taught school in Missouri; became a lawyer there and county attorney of Andrew County in 1874. Removing to Chicago in 1875 he became prominent in the Democratic party. An unsuccessful candidate for Congress in 1884, he was judge of the Chicago Superior Court 1886–91. Elected governor in 1892, one of his first official acts was to pardon three anarchists, imprisoned since 1887 (two for life and one for 15 years) for complicity in the bomb-throwing which killed seven policemen in Chicago, 4 May 1886 (see ANARCHISM; HAYMARKET MASSACRE). It should be said that many leading United States citizens had petitioned for their release on the ground of insufficient evidence, an assumption which Judge Gary (q.v.) has vigorously repelled. Altgeld was governor till 1897. He was a prominent champion of free silver and an active supporter of Bryan for the Presidency in 1896 and 1900, and was defeated as independent candidate for mayor, 1899. He was an able speaker, an efficient advocate of prison reform, and appears to have been moved chiefly by sympathy with the working class. He wrote 'Our Penal Machinery and Its Victims,' 'Live Questions,' etc.

Althæa. See HOLLYHOCK; MARSH MALLOW.

Althorp, Lord. See SPENCER.

Altiscope, an instrument consisting of an arrangement of mirrors in a vertical framework, by means of which a person is enabled to overlook an object (a parapet, for instance) intervening between himself and whatever he desires to see, the picture of the latter being reflected from a higher to a lower mirror, where it is seen by the observer.

Altitude, in mathematics, denotes the perpendicular height of the vertex of any plane or solid body above the line or plane of its base; thus the altitude of a triangle is measured by a perpendicular let fall from any one of its angles upon the base, or upon the base produced; therefore the same triangle may have different altitudes, accordingly as we assume one side or another for its base. Again, the altitude of a cone or pyramid, whether right or oblique, is measured by a perpendicular let fall from the vertex to the plane of its base. Similar remarks apply to other solids. In astronomy altitudes are measured or estimated by the angles subtended between the object and the plane of the horizon; and this altitude may be either true or apparent. The apparent altitude is that which is obtained immediately from observation; and the true altitude that which results from correcting the apparent altitude, by making allowance for parallax, refraction, etc. The altitude of a terrestrial object is the height of its vertex above some horizontal plane assumed as a base.

Alton, Ill., city in Madison co., on the Mississippi River, and on the Chicago & A., the Cleveland, C., C. & St. L., the St. Clair, M. & St. L., the St. Louis, C. & St. P., and the St. Louis, K. & N. W. R.R's; about four miles above the mouth of the Missouri River and 15 miles north of St. Louis. Its river lines of transportation include the Eagle Packet Company line, the Diamond line, the St. Louis & Clarkson, and the St. Louis, Naples & Peoria. Alton was settled early in the century, but was not incorporated as a city until 1837. The city, built upon a high limestone bluff, has very picturesque surroundings. The Mississippi River is spanned here by a railroad bridge, and the city is connected by electric railway with Upper Alton, two miles to the northeast, where is located Shurtleff College (q.v.). Monticello Seminary (q.v.) is located at Godfrey, four miles from Alton, on the Chicago, A. & J. R.R.. Alton has in addition to an extensive river and railroad trade, large manufacturing interests. The Illinois Glass Company, manufacturer of glass bottles, is located here, and gives employment to 3,200 persons. The company owns and operates a railroad and uses ¾ of the output of a large coal mine. Some of the other manufactures are flour, shovels and picks, foundry and machine-shop products, and shoes. Among the prominent public buildings are the Hayne's

Memorial Public Library, a Home for Aged Women, the St. Joseph's Hospital, the Ursuline Convent and 16 churches. The city is governed by a mayor and common council elected every two years by the people. There are two national banks, two savings banks, three daily newspapers, trolley systems and electric light. In 1837, Elijah P. Lovejoy (q.v.), the abolitionist, was murdered here. A monument to his memory was erected in 1897. Pop. (1900) 14,210; including North and Upper Alton, 18,000.
D. R. SPARKS,
Pres. of the Sparks Milling Co., Alton.

Alton Locke, a story by Charles Kingsley, published in 1850. It was his first novel, and displayed the author's broad sympathy for the condition of the English working classes. It excited immediate attention, and was an important factor in arousing the upper classes to a realization of their responsibilities toward the less fortunate. The altruism of Locke and his friends, Crossthwaite, Mackaye, Lady Ellerton, and Eleanor, forms an admirable and inspiring feature of the book.

Altoona, Pa., city in Blair County, on the Pennsylvania Railroad, 118 m. E. of Pittsburg. It has an elevation of 1,182 feet above the sea; situated in the midst of a most picturesque mountain region, at the eastern base of the Alleghany Mountains. For many years Altoona has been regarded as the most typical of American railroad towns, for here are located the immense repair shops of the Pennsylvania Railroad, and over 10,000 workmen are engaged in manufacturing and repairing locomotives, passenger coaches, and freight cars. There are other large and important manufactories here, of machinery, agricultural implements, coal-mining machinery, etc. It is also the business centre of a considerable agricultural region. The city contains a public library building, high school, several hospitals, and numerous churches and private schools. The famous Horseshoe Bend, on the line of the Pennsylvania Railroad, is located near the city, and Lakemont Park is a well-known pleasure ground within the city limits. The municipal government is vested in a mayor, city council and subordinate administrative officials, who are elected annually. The city owns the waterworks plant, which was acquired in 1872 at a cost of $680,000, and upon which $20,000 is expended annually. The city's expenses aggregate $250,000 yearly, of which amount nearly $100,000 is expended for schools. The city was founded in 1850 by the Pennsylvania Railroad Company. It was first incorporated as a borough in 1854, and chartered as a city in 1868. During the great railroad strike of 1877, Altoona was the centre of the disturbed section and troops were ordered out to protect railroad property here. It is a growing, thriving city. There are three daily and numerous weekly newspapers. Pop. (1880) 19,710; (1890) 30,337; (1900) 38,973, and estimated (1903) 41,600.

Altoona, or **Allatoona Pass**, a mountain pass in northern Georgia, the scene of a sharp engagement between the Federal troops under Gen. Corse and the Confederates commanded by Gen. French, on 5 Oct. 1864. The losses on each side were about equal.

Altrices, birds whose young come out of the egg in a helpless condition and are reared and fed in the nest. All the higher birds, as thrushes and sparrows, are of this kind. The term is opposed to *Precoces*, a name applied to birds whose young are able as soon as hatched to take care of themselves, as in the cases of game- and shore-birds.

Altruism, a term in psychology and ethics to denote disposition and conduct directed toward the well-being of others. It is contrasted with egoism, or self-seeking disposition and conduct. It is essential to altruism, as well as to egoism, that the good of others, or of self, should be consciously and intentionally pursued. Actions and dispositions which are instinctive, such as maternal instinct, are not, properly speaking, altruistic, nor are the opposite egoistic. It is only when the consciousness of self is sufficiently developed in the child to give rise to a contrast between self and the "other" (*alter*), that the conscious pursuit of the interest of one of them is possible. This is covered by psychologists by saying that real altruism and egoism are always "reflective." Altruism is also applied to the type of ethical theory which bases morality upon generous or altruistic disposition or conduct (in the sense defined above).

Altsheler, Joseph Alexander, American author and journalist: b. Three Springs, Ky., 29 April 1862. He studied at Vanderbilt University and has been connected with the Louisville *Courier-Journal* and the New York *World*. His novels are chiefly on American historical subjects: 'The Sun of Saratoga'; 'In Hostile Red'; 'A Soldier of Manhattan'; 'The Last Rebel'; 'In Circling Camps'; 'The Herald of the West'; 'My Captive'; 'The Wilderness Road'; 'The Candidate' (1905).

Al'um, in chemistry, a general name for a large class of substances, which may be defined as double sulphates or selenates, in which one of the bases is aluminum, chromium, manganese, iron, indium, or gallium, and the other is sodium, potassium, rubidium, cæsium, ammonium, silver, or thallium. The alums all crystallize in cubes or octahedra, with 24 molecules of water, and are all isomorphous, so that when in solution together they cannot be separated by crystallization. In naming them aluminum is understood to be one of the metals present unless the contrary is expressly indicated. Thus "potash alum" is the alum whose formula is $Al_2(SO_4)_3 + K_2SO_4 + 24H_2O$. If aluminum is not present, the metal that replaces it is stated; thus "iron-sodium alum" is the alum whose formula is $Fe_2(SO_4)_3 + Na_2SO_4 + 24H_2O$. When selenium replaces the sulphur in one or both of its positions, the alum is most clearly identified by giving its formula. In addition to the true alums a class of substances known as "pseudo-alums" exists. These also crystallize with 24 molecules of water, but they are not isomorphous with the true alums. $Mn_2(SO_4)_3 + MgSO_4 + 24H_2O$ is an example of this class.

All the alums are soluble in water, and it is probable that all are resolved, at least partially, into their constituents, by solution. It is known that in certain cases (in silver alum, for example) the separation is absolute. All of the alums give an acid reaction when in solution. all have an astringent taste, and all lose their water of crystallization when heated.

The alum of commerce is supposed to be potash alum, the formula of which has been already given. Ammonia alum is sometimes substituted, however, owing to the cheapness of sulphate of ammonia, which is now obtained as a by-product in the manufacture of illuminating gas. Sodium alum is probably not substituted for potash alum to any great extent.

The alums are largely used in the arts, especially in dyeing and tanning, and in the purification of water. Bread made from flour containing a small amount of alum is said to be very white, and partly for this reason and partly on account of the cheapness of the substance, ammonia alum has been largely used in the manufacture of baking-powders. This practice has been condemned and pronounced detrimental to health, however, by nearly all the authorities who have written on the subject.

Alums may be formed by crystallization from the mixed sulphates, or by roasting "alum-stone" (see ALUNITE). Some of them occur native. (See MENDOZITE; TSCHERMIGITE.)

Alum Poisoning.— This poisoning may be acute or chronic, the latter being much more common. In the acute variety, often the result of accidental drinking of a gargling solution, the symptoms are nausea, vomiting, purging, cold clammy skin, small thready pulse, thirst, muscular tremor, followed by a rise in temperature in those that have recovered. The treatment pursued in the case of alum poisoning is to wash out the stomach and use the white of eggs as a chemical antidote.

Alum being so widely employed as a preservative, as a means of clarifying water, and as an adulterant in baking-powders, the question of chronic alum poisoning becomes of great importance. The symptoms that have been most frequently observed in such poisoning are disturbances of digestion and constipation. The question as to its harmful action on the kidneys is not yet decided, but it would seem to be harmful rather than the reverse.

Alumbagh, a domain in India formerly belonging to one of the princes of Oudh, about 4 m. S. of Lucknow, near the road to Cawnpore. It comprised a beautiful palace, a mosque, a temple, and other buildings surrounded by a garden, all in the centre of a magnificent park enclosed by a lofty wall with turrets at each angle. On the outbreak of the Indian mutiny this place was occupied by the revolted Sepoys and converted into a fort. On 23 Sept. 1857 it was captured by the British, then on their way to relieve Lucknow. Leaving a garrison of 300 European troops, together with the sick and wounded and about 4,000 native camp-followers, the main body, under Outram, Havelock, and Neill, pushed on to Lucknow. These generals were unable to send reinforcements, but at the end of November the place was relieved by Sir Colin Campbell. The latter left Sir James Outram, with a force of 3,500 men, to hold the Alumbagh, a task which he successfully accomplished, though repeatedly attacked by overwhelming numbers of the rebels. In March 1858 the garrison was finally relieved. At the foot of a tree within the grounds Sir Henry Havelock was buried.

Alumina (Al_2O_3), the only oxid of the metal aluminum. As found native, crystallized, it is only second to the diamond in hardness. The transparent varieties are the sapphire and ruby, the opaque are corundum and emery, only the corundum being pure. In combination with silica it is one of the most widely distributed of substances, ranking in this respect next to oxygen and silicon. It enters in large quantity into the composition of granites, traps, slates, schists, clays, loams, and other rocks. The hydrated oxid, $Al_2O_3.H_2O$, occurs as diaspore, and with ferric oxid as bauxite. Various aluminates occur in certain gems, as in spinel and chrysoberyl. Alumina may be obtained by adding a solution of ammonium hydrate to purify alum dissolved in 20 parts of water, thoroughly washing the very gelatinous precipitate formed, and then drying it carefully. It may also be prepared by igniting powdered aluminum in air or oxygen. Alumina is a white powder, without taste or smell, and infusible except in the oxyhydrogen flame. It is the basis of porcelain, pottery, bricks, and crucibles; and it has a strong affinity for oil and coloring matter, which causes it to be employed in the state of clays as a cleansing powder, and in a state of purity in the preparation of the colors called lakes, in dyeing and calico-printing. It combines with the acids, and forms numerous salts, the most important of which are the sulphate (see ALUM) and the acetate. The latter salt is formed by digesting strong acetic acid (vinegar) with the newly precipitated earth; but for the use of the manufacturer, by decomposing alum with acetate of lead (sugar of lead), or more economically with acetate of lime, a gallon of which, of the specific gravity 1.050, is employed for every 2¾ pounds of alum. The sulphate of calcium formed falls to the bottom, and the acetate of aluminum remains in solution with an excess of alum, which is necessary to prevent its decomposition. It is of extensive use in calico-printing and dyeing, as a mordant, and is employed in the place of alum, to which it is generally preferred.

Aluminite, a mineral having the composition of a hydrous aluminum sulphate, $Al_2O_3.S\,O_3.\ 9\,H_2O$, occurring in white reniform concretions in beds of clay in Germany, England and other European countries. It is opaque, of earthy luster and fracture, is soft and light.

Alumino-Thermics. The new science called *Alumino-Thermics* is based on the discovery that by producing in a suitable manner the chemical combination of oxygen and aluminum a temperature may be created equal to that of the electric arclight. When this mixture is ignited in one spot the combustion continues throughout the whole mass in a very short time without any supply of heat from outside.

In the crucible after the reaction there are two layers. The bottom one is pure metal of equal weight to, but occupying only one-third of the space of, the top layer, which is now oxide of aluminum, so-called corundum. These two layers whilst still liquid are poured rapidly over the rim of the crucible. It is not difficult to distinguish between the slag which flows first and the brightly glittering overheated metal.

About 50 years ago, attempts were made to apply the reducing properties of aluminum. Without exception the experimenters

heated their compounds externally. The reaction was always so violent that they could only operate with very small quantities. It will easily be seen that to arrive at alumino-thermics on a commercial scale from such a starting point required patient study and assiduous work. The recipes for gunpowder or dynamite sound fairly simple, but it requires more than a mere mixture of the ingredients to obtain any effect sufficient for industrial development.

In all exothermic processes the physical properties of the ingredients, in this case particularly those of the oxides, need considering. Then the methods of manufacture have to be worked out for each case. The applications may be roughly divided into two main divisions, the one concerning the metallurgist, the other the engineer. The latter application may be summarized in the word "welding." The study of the metallurgical application preceded that of the other by a few years.

Among the pure metals produced by the alumino-genetic reaction may be mentioned in the first instance chromium free of carbon. It is used in the manufacture of particular qualities of chromium steel with a limited percentage of carbon, and nowadays hardly any high-speed tool steel is made without it. Pure manganese also produced by this process finds employment in copper and nickel manufacture, and, furthermore, in the production of particular sorts of manganese steel of great strength and great elasticity with 12 to 14 per cent. manganese, used particularly for bolts of machinery exposed to great strains. Pure molybdenum and ferro-vanadium have also lately been put on the market. Ferro-titanium has been in use with a number of steel works for quite a considerable time.

Considering the innumerable details connected with the application of so new and practically unknown a force, it is not surprising that only since a few years the process has been introduced on a large and commercial scale. The most important of these welding processes is the one by which a continuous rail — a necessity of modern trolley-road construction — is simply, cheaply and effectively obtained. The marked advantage enjoyed by this system is the absence of any bulky equipment; a crucible, a mould box, and, in some rare instances where a complete butt weld of the head of the rail is desired, a rail-clamp is all that is required. All these materials, including the necessary quantity of thermit, can easily be moved on a hand truck. Each weld, according to the section, requires from 15 to 20 pounds of thermit, and the metal welded around the joint will only weigh, therefore, from 8 to 10 pounds.

The thermit reaction takes place in a crucible which rests on a simple iron stand, that can be attached to the rails or rail-clamps where such are used. The crucible consists of a sheet-iron mantle lined with magnesia or corundum slag, which is tamped round a sheet-iron conus suspended in its middle. The bottom is formed by a hard magnesia stone provided with an exchangeable outlet which will stand 9 or 10 runs. The life of the crucible itself is about 25 reactions; the wear and tear will amount, therefore, to only a few cents per joint. The crucible is plugged by inserting two asbestos washers covered by a metal disk over the outflow or thimble. In the latter is suspended a piece of iron wire, the lower end of which projects below the base of the crucible. This is driven up by a sort or spade and so "taps" the crucible. The heat of the thermic reaction might in spite of the asbestos washers burst through the plugging material. To prevent this the metal disk is further covered by a layer of magnesia sand. The thermic is then poured into the crucible from bags containing the necessary amount for each section. After the charge in the crucible has been ignited in the usual way the reaction takes its course and the crucible is tapped to allow the liquid steel to flow into the mould.

The mould is made according to a special design for each section. Its two parts, one on each side, exactly fit and firmly enclose the rail. It must be dry and porous. On a large scale moulds can be made by manufacturers of refractory earthenware or by railway lines, according to their requirements, in their own shops, by tamping an ordinary mixture of loam and sand in equal parts into a sheet-iron case placed over the model. This sand mould must be dried during a couple of hours at a temperature of about 100° C. Before placing the mould round the joint, the rail ends must be cleaned of dirt and rust with a wire brush and slightly warmed. In case the tops of the rails are to be butt-welded the sections must be filed. The great heat of the liquid thermit steel literally melts and amalgamates the ends of rails projecting into the moulds, making them as one, so that when cool it leaves a continuous rail. The joint, if anything, is stronger than an equal section of the rail, from the fact that a shoe or collar is left around the rail at the joint of thermit steel.

As the whole heating of the rail ends is a uniform one, and the same is done without exposure to the atmosphere; and as the final cooling is done under the same conditions as that under which a rail is made, it has been found that there are no changes in the ingredients or temper of the steel in the rail, and it is left just as it was, except that the ends are melted together up to, and generally a little above the bottom of the tread of the rail. If the alignment and surface of the rail at the joint was perfect before making the weld, it will be found to be the same after, except that a slight longitudinal expansion has taken place, caused by the heat; and all of this is to the benefit of the joint, for with the heat it tends to butt-weld the heads; in fact, it does so if the rail ends touch each other when the weld is made.

The cost of relining crucibles and moulds amounts to but a few cents per joint, and experience shows that the item of labor per joint should not run over 15 cents. The system can be applied on short lines with the

same economy as on long ones, for it is only a question of the number of men, and consequently the number of joints required per day. It is especially an ideal system for repairing old worn joints, for but little paving need be taken up (sufficient to take off the old fishplate), and in a few minutes a joint may be raised and welded, and that would prolong the life of an old track for many years. The strength of the weld is about 80 per cent. of the strength of the original material. The shoe welded on to the foot of the rail not only makes up for the remaining 20 per cent., but materially strengthens the rail at the joint.

The so-called third rail is also welded by this means. The skin resistance of copper bonds increases with time, and frequent repairs are necessitated thereby. Welding obviates these repairs. It can be done in two ways. The first is identical with the one described (but without the use of clamps), and is now in extensive operation. The second consists in welding a small bridge of thermit iron between the feet on one side of the rail. The other side of the joint, where there is no thermit-welded bridge, is mechanically strengthened by an ordinary light fishplate. In this case the crucible is superflous. The welding portion of about three pounds only is placed directly into the upper part of the mould, which is prolonged by a piece of gas pipe.

The question of the continuous rail with exposed T rails on railroads is not solved at present for want of sufficient tests. Of course, welding is the only means by which a continuous rail, properly speaking, can be obtained with exposed rails. That it is practicable within certain limits and that it is desirable to have greater lengths of exposed track welded together is admitted by permanent-way engineers. The question is being investigated at present, but some time must elapse before a definite opinion can be arrived at. In any case exposed rails can undoubtedly be welded without any risk in tunnels and subways, where differences of temperature are very slight, and contraction and expansion therefore only minimal.

Steel girders for construction work can, of course, be welded in the same way as rails. For really solid jointing equal to the strength of the girder itself, welding is necessarily cheaper than riveting. Considerable work of this kind has already been done in Germany, but in Europe there are few of the wonderful steel-girder constructions which so greatly impress the European on his arrival in this country. There is a wide field for this work in the United States as soon as the preparatory experiments and calculations have been made and officially sanctioned.

The result of the reaction in the crucible is a liquid iron, which sinks to the bottom, and an aluminum slag that swims on the top. Whoever has a supply of thermit and ignition powder has a supply of liquid mild steel, which, on account of its low contents of carbon, 0.1 per cent., is very malleable and ductile. Foundries can correct faulty castings, machine shops can mend broken or worn out parts, and last, but not least, marine engineering works can repair large steel castings, such as crank shafts, and particularly broken sternposts. The weld can either be effected by running the thermit iron round the ends of the piece in the shape of a ring, or by both running it between and around at the same time.

The mould must be made of sand and loam in equal parts, or one-third sand and two-thirds china clay. It must be absolutely dry. Thermit steel being much hotter than steel out of a furnace, the mould must have no trace of moisture. Dry first gradually and then in the furnace to dull red heat. The quality of the thermit steel may be adapted to various requirements by mixing small, clean iron punchings, or the like, into the thermit powder. For 5 to 10 pounds or more an admixture of 5 to 10 per cent. of punchings will not make the overheated steel lose the property of melting and fusing with the metal with which it comes in contact. The proportion of punchings may be increased considerably (even 20 to 25 per cent.) for larger operations. Iron or steel punchings will moderate the temperature of the reaction, and increase, of course, the quantity of the metal available for the weld.

The most startling, and at the same time, the most effective work done in the way of repairs by the thermit is in connection with marine engineering. To weld broken sternpost of large trans-Atlantic liners, or crankshafts, or similar pieces, crucibles of six feet in height, with a capacity of seven to eight cwt., have been constructed. The reaction in these hardly takes longer than in a small crucible. The enormous advantage offered to steamship owners by such repairs will be apparent when it is remembered that a broken sternpost would otherwise have to be replaced by a new one. Besides this expense, the one incurred through loss of time, the steamer being laid up in dry dock for many weeks in order to have the new part fitted in, is very heavy indeed.

In nearly all experiments the thermit is ignited in a crucible so as to allow the liquid steel to flow out independently from the much lighter slag. The slag is not used in welding solid pieces, except as an additional reservoir of heat. The slag, however, has the peculiar property of adhering instantly in a thin layer to any cold metal object with which it comes in contact. Were thermit to be ignited directly on a piece of metal, the slag would get in between the liquid steel and the object to be operated upon, and would prevent the fusion of the two metals, which is essential for a good weld.

An application where thermit may be ignited on the object, is in repairs of broken roll bosses. The roll is firmly fixed so that the welding surface lizes horizontally. The mould carries on its inside, suspended by an overlapping rim, an iron ring of one-half inch diameter. After this mould and ring are firmly fixed one-half inch of liquid cast iron or cast steel is poured on the welding surface. On this the thermit powder is

poured and ignited. About 30 to 40 pounds are taken for the superficial foot. This will soften the metal to a depth of about two inches. As soon as the reaction is finished the thermit must be well stirred. The slag, on account of its low specific gravity, will thus be driven to the surface, and will cling to the iron ring which is suspended in the mould. After a few minutes more liquid steel is added from the ladle held in readiness, and after thoroughly stirring the contents of the mould the iron ring is lifted out, and all the slag will be found adhering to it. This repair is in common use with the largest works in Germany.

The property of the slag of adhering in a thin refractory layer to any metal surface leads to an application of the thermic process where it plays the leading part — that is, in welding wrought-iron pipes. Of course, the heat of the iron, if applied direct, would destroy the thin walls of any pipe. But as the slag is absolutely refractory to liquid steel, it replaces in a way the steel for the purpose of welding. The *modus operandi* is changed in some essential particulars. The reaction takes place in a crucible with a solid bottom; a small quantity of thermit only is ignited at first, and to this more is added as the mass subsides, and finally the contents are poured over the lip of the crucible in order to direct the slag, and not the iron, onto the thin walls of the pipe. To butt-weld the pipes, the ends must be made to fit accurately on to each other, and must be made bright with a file or emery paper. The two pipes are then firmly pressed together by the clamping apparatus, and the sheet-iron mould, well surrounded with moist sand, is attached. Welding temperature will take place within a minute or two after pouring. The clamps then want tightening one turn of the screw, and the weld is completed. The mould box is removed almost at once, and can be used several times.

The surrounding mass, containing the iron between layers of slag, like the yolk in the white of an egg, is easily removed with a hammer. Such welds will stand pressure of hundreds of atmospheres — as a matter of fact, as much as the pipe itself. About 30,000 to 40,000 pipe joints have been welded by this method, the advantages of which are, shortly, that the operation can take place anywhere without removing the pipe from its position, and that it is cheaper than a solid flanged joint. The dimensions of the mould have been carefully worked out and tabulated for every size of wrought-iron pipe up to six inches diameter. The thermit used for pipe welding is of slightly different composition to the one for welding solid pieces. Besides these there are two other kinds of thermit, chiefly distinguished by the greater plasticity of their slag. One of these, so-called "white thermit," is used for annealing locally the plates of armor-clads, which are hardened to such an extent by carburization as to prevent any tools being used on them. Such armor plates can be easily softened by applying to the hardened surface a layer of thermit slag with thermit steel at the back of it.

For cast iron, and in some cases for steel, a special thermit is used which gives off an alloy of iron and titanium so that the titanium enters the liquid metal. This is introduced below the surface of the bath by fastening the box containing the thermit to a shank and holding it down on the bottom of the ladle. The reaction takes place all through the contents of the ladle and thoroughly stirs them up in the space of a minute or two. Gases and particles of slag are driven upwards, so that the fluidity of the iron is increased. The proportion of added thermit is only one-quarter to one-sixteenth per cent. of the total contents of the ladle. The effect of the titanium is to bind small quantities of nitrogen to increase the fluidity of the cast iron, and to produce a finer grain.

Another application of the "box-reaction" is important for steel castings, and especially for casting large steel ingots, to prevent the familiar phenomenum of piping. In the heads of such blocks hollow spaces are found which mostly cause 30 to 40 per cent. of loss. The thermit process as used for this purpose consists in introducing a box of anti-piping thermit into a block with aid of an iron rod. The box is introduced, of course, only after the piping has been formed. The head layer, which has already become solid, is broken through for this purpose. Immediately after the reaction is completed, steel which is held in readiness for this purpose is poured into the open hole. The method is really very simple, and one learns very quickly at which time to introduce the box. Moreover, it is very cheap, only about 10 pounds of thermit being required for blocks of 20 tons weight.

The simplest, and at the same time, most effective application of thermit in foundry practice is the following: Wrap thermit in a paper parcel and throw it on the liquid metal as it rises in the riser. The liquid metal will be revived at the point where it is most liable to chill, and the well-known troublesome shrinkage cavities will be avoided. When applied to cast iron the paper must contain some ignition powder at the bottom; with steel this is unnecessary.

EDWARD S. FARROW,
Consulting Railroad and Mining Engineer.

Alu'minum, a lustrous, nearly white metal, widely used in the arts. Its existence was recognized by Davy, although he did not succeed in isolating the metal. Davy gave it the name "alumium," and afterward "aluminum."

The name is derived from the Latin word *alumen*, signifying "alum"; but the Romans and the Greeks had no very exact knowledge of chemistry, and *alumen* and its Greek equivalent were used to designate a variety of substances whose one common property is an astringent taste. The substance now called alum was in all probability included among them, for it was well known to Geber. Alum was long believed to be of the same nature as the vitriols, until Paracelsus announced that the vitriols contain metals, while alum (he said) does not contain a metal, but derives its properties from an "intermixture of the earths." It was long believed that the earth contained in alum is of a calcareous or lime-like nature; but in the 17th century it was noticed that an alum may be obtained by treating clay with sulphuric acid, and in a

treatise published in 1746 Pott stated that the earth forming the base of alum is of an argillaceous or clay-like nature. Eight years later, in 1754, Marggraf announced that alumina, the earth (now called the oxid) of alum, is entirely different from lime, and that it exists in clay, combined with silica. At the beginning of the 19th century alumina was generally admitted to be the oxid of some metal and Sir Humphry Davy and other chemists endeavored to decompose it and obtain the metal itself. They were unsuccessful, however, and the isolation of aluminum was first accomplished by Wöhler in 1827, by heating the chloride of alumina with metallic potassium. The potassium abstracted the chlorine and thereby set the aluminum free. Paracelsus was wrong in asserting that the base of common alum is not a metal, but his error was due to his pardonable ignorance of the fact that all the so-called "earths" are oxids of metals.

The new metal proved to be most remarkable. Although it had so powerfully resisted all the earlier attempts to separate it from the oxygen with which it was combined, yet, when the separation had once been effected, it was found that the metal exhibits no very marked tendency to oxidize, even when heated in oxygen. It is nearly white, but has a slightly bluish tinge. It is about as hard as silver and is very malleable and ductile. It can readily be drawn out into wire or beaten into leaf. It takes a good polish, especially when alloyed with about three per cent of silver. It has a tensile strength about equal to that of copper, and a specific gravity of only about 2.6. It melts at about 1,300° F., its specific heat is 0.221, its coefficient of expansion (Fahrenheit scale) is 0.00129, and its atomic weight is 27.1. Bars of the metal emit a very musical sound when struck, but it is said that a bell made of it "sounds like a cracked pot." Aluminum is very feebly magnetic. It is scarcely affected by nitric acid, though hydrochloric and sulphuric acids will dissolve it, and it is entirely unaffected by sulphur, except at high temperatures. Solutions of caustic potash or soda, however, dissolve it readily, with evolution of hydrogen.

Aluminum is exceedingly abundant in nature, for next to oxygen and silica it is the chief component of the earth's crust. Feldspar and mica contain it in considerable quantities, as well as common clay, which is formed by the disintegration of feldspar. The oxid of aluminum occurs in many beautiful forms, giving us the ruby and the sapphire, besides forming an essential part of the garnet, topaz, turquoise, and emerald. Corundum and emery, which are almost indispensable for grinding and polishing purposes, are also forms of the oxid. Kaolin, used in the manufacture of porcelain, is a very pure silicate of aluminum. The beautiful lapis-lazuli contains a considerable proportion of aluminum; and ultramarine blue, formerly obtained by pulverizing lapis-lazuli, is now prepared artificially from kaolin, together with other substances. The red color of the ruby is due to a trace of certain chromium salts, and the blue of the sapphire is probably due to a trace of some compound of cobalt. By melting oxid of aluminum in the oxyhydrogen blow-pipe flame, adding a slight amount of certain metallic oxids, and cooling again, artificial rubies and sapphires have been made which are indistinguishable from the natural gems, except to the eye of an expert.

Although aluminum is far more abundant than tin, copper, lead, zinc, or iron, it can be extracted from the minerals in which it occurs only with the greatest difficulty. Until very recently the aluminum of commerce has been prepared by substantially the method first given for its isolation by Wöhler, the chief difference, aside from matters of practical detail, being the substitution of metallic sodium for the more expensive potassium. At the present time, however, practically all of the aluminum that is produced is obtained by electrolysis. Prof. C. F. Chandler describes the Hall process (which differs from the Heroult process only in its details) as follows: "It was a remarkable fact, after all the attention that had been devoted to the subject of aluminum by St. Claire Deville and other chemists, that it remained for a young graduate of Oberlin College, Charles M. Hall, to devise the process by which all the aluminum in the world is now manufactured. It occurred to young Hall, whose attention was drawn to the subject while he was still a college student, that some way might be found for extracting aluminum by electrolysis. Satisfied that it would be impossible to employ an aqueous solution, he sought for other solvents, and finally discovered that a melted bath of the double fluorides of aluminum and metals more electro-positive than aluminum (such as sodium or calcium) is a perfect solvent for alumina, taking it up as promptly as hot water takes up sugar, and dissolving as much as 25 per cent of its weight. Having thus found an anhydrous solvent for alumina, the next step was to ascertain whether the solution would yield up the aluminum promptly to electrolysis." The most gratifying success attended these further experiments, and the practical details of the process were worked out at Kensington, Pa. The vessels or pots employed in the making of aluminum by this method are rectangular iron boxes, thickly lined with carbon, which constitutes the cathode. The anodes consist of 40 cylinders of carbon, each about 3 inches in diameter and 18 inches long when new. These are supported above the pot, dipping into the bath of melted fluorides. No external heat is employed, the heat developed by the resistance to the current being sufficient to maintain fusion. Alumina is added from time to time as required, and the process goes on quietly. The resistance of the bath is low when charged with alumina, but it increases fourfold the moment the alumina is exhausted. An incandescent lamp, connected with each bath in parallel, emits no light while the resistance of the bath is low, but the moment the resistance is increased by the exhaustion of the alumina the lamp begins to shine and the workmen hasten to stir in a fresh supply of alumina. The process is continuous, and it is only necessary to keep the baths supplied with alumina and to draw off the metallic aluminum from the bottom of the pot from time to time. Each pot produces about 100 pounds of aluminum, 99 per cent pure, per day of 24 hours.

The electric resistance of aluminum is about twice that of copper, but owing to the lightness of aluminum and its constantly diminishing price (about 30 cents a pound in 1902) it bids

fair to be a serious rival of copper in the transmission of electricity. Many long lines of aluminum wire have been installed in the West. One of the most interesting, in the East, is a line used to transmit power to Hartford, Conn., from a point on the Farmington River, about 12 miles distant. Three aluminum cables are used, containing over 60,000 pounds of metal. The line was designed for 20,000 volts, and it is said that in this instance the use of aluminum instead of copper has proved an entire success, both electrically and financially.

The most valuable property of aluminum is perhaps the facility with which it alloys with most other metals except lead. It has been alloyed with bismuth, calcium, copper, chromium, gold, iron, magnesium, manganese, mercury, molybdenum, nickel, platinum, silver, sodium, tin, titanium, tungsten, and zinc. Some of its alloys with gold are very beautiful, and it has been proposed to use one of them in the manufacture of coins. An alloy with nickel called "nickel silver," promises to be useful in the future, as it is strong and easily worked and has a beautiful white lustre that will not tarnish. The most useful alloys of the metal at present are those with copper, which are known as "aluminum bronzes." The alloy containing 3 per cent of copper is whiter than aluminum; and that containing from 90 to 95 per cent of copper has a color resembling gold. Aluminum bronze is hard and elastic and is not easily affected by chemical reagents. It is much used in the manufacture of articles of all kinds, from cheap jewelry to heavy bearings for machinery. (For information concerning the working of aluminum and other technical points consult J. W. Richards, 'Aluminum, Its Properties, Metallurgy, and Alloys,' Philadelphia, 1890.)

Notwithstanding the abundance of aluminum in nature, it is not taken up by plants save by a few cryptogams. The ash of *Lycopodium chamæcyparissus* sometimes contains 57 per cent of alumina, while the ash of oaks, figs, and birches, grown in the same soil, contains none.

Alum-root, the name given in the United States to two plants on account of the remarkable astringency of their roots: (1) *Geranium maculatum*, or spotted cranesbill, is a native of North America from Canada to North Carolina; it has an angular, downy stem, 3-5-parted leaves with deeply toothed lobes, obovate entire petals, the filaments scarcely ciliated at the base; the color of the flowers is a pale lilac. It is employed successfully as a remedy in dysentery among children; the tincture is recommended in cases of ulcerated sore throat, soreness of the gums, etc. The plant contains large proportions of gallic acid and tannin. (2) *Heuchera americana* (natural order *Saxifragaceæ*) is a downy plant with rough scapes and leaves, the latter being on long petioles, 5-7-lobed, toothed; the calyx is 5-cleft, petals undivided, five stamens; the styles are remarkably long. It contains tannin and is used in preparing a wash for wounds, ulcers, etc.

Alum-shale, a slaty rock of different degrees of hardness; color grayish, bluish, or iron-black; often possessed of a glossy or shining lustre. It is chiefly composed of clay (silicate of alumina), with variable proportions of sulphid of iron (iron pyrites), lime, bitumen, and magnesia. It is found abundantly, and from it is obtained the largest part of the alum of commerce.

Alunite, al'ū-nīt, a native subsulphate of aluminum and potassium, having the formula $K(AlO)_3(SO_4)_2 + 3H_2O$, and occurring both massive and in rhombohedral crystals resembling cubes. It is white with a vitreous lustre, with a hardness varying from 3.5 to 4, and a specific gravity of about 2.6. It has been found, in the United States, in California and Colorado. According to Dana it was first called "aluminilite," a name afterward abbreviated to the present form. Alum may be obtained from it by repeated roasting and lixiviation. (Also called alum-stone and alum-rock.)

Alun'no, Niccolo (real name Niccolò di Liberatore), an Italian painter of the 15th century, the founder of the Umbrian School: b. in Foligno about 1430; d. 1502.

Alunogen, a-lū'nō-jen, a native hydrous sulphate of aluminum, having the formula $Al_2(SO_4)_3 + 18H_2O$. It occurs massive, as an incrustation in mines and quarries, and also in delicate fibrous forms. Its hardness varies from 1.5 to 2, and its sp. gr. is about 1.7. It occurs in large quantities in Jackson County, N. C., and near Silver City, N. M.; and it is found in many other parts of the United States in small amounts.

Aluredus, an English historian: b. about 1100. See Alfred of Beverley.

Alva, or Alba, Ferdinand Alvarez de Toledo, Duke of, Spanish statesman and general: b. 1508; d. Thomar, 12 Jan. 1582. He was educated by his grandfather, Frederick of Toledo, who instructed him in military and political science. He commanded under Charles V. in Hungary, and was present at the siege of Tunis and in the expedition against Algiers. His cautious character and his inclination for politics at first led men to believe that he had but little military talent; and his pride being touched at the low estimation in which he was held, his genius was roused to the performance of exploits deserving remembrance. He won in 1547 the battle of Mühlberg against John Frederick, elector of Saxony, and in 1555 was commissioned to attack the French in Italy, and Pope Paul IV., the irreconcilable enemy of the emperor. When Charles V. resigned the government to his son, Philip II., Alva received the supreme command of the army and conquered the states of the Church and frustrated the efforts of the French. Philip, however, compelled him to contract an honorable peace with the Pope, whom Alva wished to humble. He appeared in 1559 at the French court in order to marry Elizabeth, the daughter of Henry II., by proxy, for his sovereign; she had been at first destined for the crown-prince, Don Carlos. About this time the Netherlands revolted, and Alva was entrusted with a considerable army and unlimited power to reduce the rebellious provinces. Scarcely had Alva reached Flanders at the end of August 1567, when he established the Council of Blood, at the head of which stood his confidant, Juan de Vargas. This tribunal condemned, without discrimination, all those whose opinions were suspected and whose riches excited their avarice. The present and absent, the living and the dead, were subjected

to trial, and their property confiscated. The cruelty of Alva was increased by the defeat of his lieutenant, the Duke of Aremberg, and he caused the Counts of Egmont and Hoorn to be executed. He afterward defeated the Count of Nassau on the plains of Gemmingen. Soon after, the Prince of Orange advanced with a powerful army, but was forced to withdraw to Germany. The Duke stained his reputation as a general by new cruelties, his executioners shedding more blood than his soldiers. The pope presented him with a consecrated hat and sword, a distinction previously conferred only on princes. Holland and Zealand, however, still resisted his arms. A fleet fitted out at his command was annihilated, and he was everywhere met with insuperable courage. This, and perhaps the fear of losing the favor of the king, induced him to request his recall. Philip willingly granted it, as he perceived that the resistance of the Netherlands was rendered more obstinate by these cruelties, and was desirous of trying milder measures. In December 1573 Alva proclaimed an amnesty, resigned the command of the troops to Louis de Requesens, and left the land in which he had executed 18,000 men, as he himself boasted, and kindled a war that burned for 68 years, cost Spain $800,000,000, its finest troops, and seven of its richest provinces in the Low Countries. Alva led an army into Portugal, gained two battles in three weeks, drove out Don Antonio, and reduced all Portugal, in 1581, to subjection to his sovereign. He made himself master of the treasures of the capital and permitted his soldiers to plunder the suburbs and surrounding country with their usual rapacity and cruelty. It is said of him that during 60 years of warfare he never lost a battle and was never taken by surprise.

Alvarado, Pedro de, a Spanish soldier of fortune, the companion and lieutenant of Cortez: b. Badajoz about 1499; d. 1541. He was of good family, his father being a knight of the order of St. James. In 1518 he accompanied Grijalva in a small expedition sent by Velasquez, governor of Cuba, to explore the American coast. A considerable amount of the precious metals was obtained by barter, and Alvarado was despatched to Cuba with this treasure and with a report of the regions which had been explored. When Cortez was called away to meet Narvaez, who had been sent by Velasquez with a superior force to supersede him in command, he left the capital and his royal captive, Montezuma, in Alvarado's charge, and in 1523 was sent with a considerable force to reduce the tribes of Indians in the direction of Guatemala. Having beaten off all opponents he founded a city now called Guatemala la Vieja, and established a port on the Pacific, which he called Puerto de la Posesion. Embarking for Spain, he was received with great honor by the emperor Charles V., who, in acknowledgment of his services, made him governor of Guatemala. He shortly returned to America with a numerous band of knights and kinsmen, and Guatemala speedily became a prosperous city. An attempt which he subsequently made on Quito, but which he was induced to relinquish, was resented by Pizarro as an intrusion within the boundaries of his command, and he embarked a second time for Spain to vindicate his conduct to the emperor.

Alverstone, Sir **Richard Everard Webster,** first baron A.; British Lord Chief Justice; b. 22 Dec. 1842. He was educated at King's College, the Charterhouse Schools, and Trinity College, Cambridge. In 1868 he was called to the bar and became Q. C. ten years after. He was appointed attorney-general in June 1885 in the Conservative Government, and in spite of the fact that he never held the position of solicitor-general and did not at the time occupy a seat in Parliament. He was elected for Launceston in the following month and later exchanged his seat for the Isle of Wight which he continued to represent until his elevation to the House of Lords. Except under the brief Gladstone administration of 1886 and the Gladstone-Rosebery Cabinet of 1892–5. Sir Richard Webster was Attorney-General from 1885 to 1899. In 1893 he represented Great Britain in the Bering Sea arbitration, and five years later he discharged the same function in the matter of the boundary between British Guiana and Venezuela. In 1899 he succeeded Sir Nathaniel Lindley as Master of the Rolls, at the same time being raised to the peerage as Baron Alverstone. In October of the same year he was elevated to the office of Lord Chief Justice upon the death of Lord Russell of Killowen.

Alvey, Richard Henry, American jurist: b. 1826. He was admitted to the bar in 1849; was a member of the Maryland State Constitutional Convention; chief judge of the Fourth Judicial Circuit, and a judge of the Maryland court of appeals in 1867-83; chief-justice of the latter court in 1883-93; became chief-justice of the court of appeals of the District of Columbia in 1893, and one of the Venezuela boundary commissioners in 1896.

Alvord, Benjamin, American soldier: b. Rutland, Vt., 8 Aug. 1813; d. 17 Oct. 1884. Received a military education at West Point, and after serving in the second Seminole war, and in the Mexican war also, was paymaster of the Department of Oregon, 1854-62. He was brigadier-general of volunteers, 1862-65, retiring from the service in 1881 with the rank of brigadier-general. He published 'Tangencies of Circles and of Spheres' (1855); and 'The Interpretation of Imaginary Roots in Questions of Maxima and Minima' (1860).

Alvord, Henry Elijah, American soldier: b. Greenfield, Mass., 11 March 1844. He entered the army in 1862 and had risen to the rank of major in 1865. He was a cavalry captain in the regular army 1866-72, and chief engineer on Gen. Sheridan's staff 1868-69. From 1886 to 1888 he was professor of agriculture in the Massachusetts Agricultural College, and was president of the Maryland Agricultural College 1888-92. He has for many years been prominent as an authority on agricultural questions.

Alwar, a town of Hindustan, capital of state of same name, situated at the base of a rocky range of quartz and slate, 80 m. S.S.W. of Delhi. It is surrounded by a mud wall, of which the gates only are flanked by bastions, and it is very poorly built. The only edifices worth notice are the rajah's palace, which is of a cubical form and has its walls pierced with numerous small windows and decorated with rude and glaring paintings; a pavilion of white marble, built by the late Rao Rajah, near a very deep tank which he had executed, and displaying no small degree

of taste; and several Hindu temples, in a style imitated from Mohammedan structures. A fort, crowning the lofty mountain which overhangs the town, is highly ornamented and serves the rajah both as a summer palace and as an asylum in times of danger. Pop. (1901) 56,750.

Amadis, a name appearing frequently in the chivalric poetry of the Middle Ages. Of the numerous romances that may be grouped under it, that which narrates the adventures of Amadis of Gaul is at once the most ancient and the best. It is believed that the earliest forms of the story were a lost Castilian version, about 1250, and a Portuguese version, also lost, composed about 1370 by Vasco de Lobeira of Porto. Very likely these earlier versions may have been in verse. Instead of these we have a Spanish prose version written by Garcia Ordoñez de Montalvo about 1465, but first printed in 1508. This romance is one of the three spared by the licentiate and the barber at the burning of Don Quixote's books, and the barber's reason is that "it is the best of all the books of this kind."

The Spanish Amadis romances consist of 12 books, of which the first four contain the history of Amadis of Gaul. The earliest existing version of this is, as has been said, that of Montalvo, and the earliest edition now in existence is dated 1508. He himself added a fifth book containing the adventures of Esplandian (1510), the eldest son of Amadis and Gloriana; later writers have multiplied the posterity of the old hero. Already in 1510 appeared a sixth book with the history of Florisando, his nephew; in 1514, 1526, and 1535, respectively, a seventh, eighth, and ninth book, with the wonderful histories of Lisuarte of Greece, a son of Esplandian, and Perion of Gaul, and the still more wonderful history of Amadis of Greece, a great-grandson of the Gallic hero. Then follow Don Florisel of Niquea and Anaxartes, son of Lisuarte, whose history, with that of the children of the latter, fills the tenth and eleventh books. Lastly, the twelfth book, printed in 1546, narrates the exploits of Don Silves de la Selva, son of Amadis of Greece and Finistea. A French translation appeared in 1540, an Italian in 1546, an English in 1588, while a version in German was published in 1583. The French translators increased this series of romances from 12 to 24 books; the German, to 30. Lastly, a Frenchman, Gilbert Saunier Duverdier, at the beginning of the 17th century, arranged all these romances into a harmonious and consecutive series, and with his compilation in seven volumes, the 'Roman des Romans,' brought the history of Amadis and the series of about 50 volumes to a close. A version in French was published by Creuzé de Lesser in 1813; in English, by William Stewart Rose, in 1803.

Amador, Manuel, first president of the Republic of Panama: b. 1841; was for many years minister of France in Panama. He is a soldier, statesman, scholar and diplomat, and was largely instrumental in forming the new Republic of Panama (q.v.).

Amalgam, an alloy in which mercury is an important constituent. Silver and gold amalgams occur in nature to a limited extent, but most of the amalgams are of artificial origin. Four general methods of forming them may be noted. (1) By direct contact of mercury with the metal to be amalgamated. Amalgams of antimony, arsenic, bismuth, cadmium, gold, lead, magnesium, potassium, silver, sodium, tellurium, thorium, tin, and zinc may be obtained in this way. The different elements mentioned combine with the mercury with varying manifestations of affinity, the amalgamation of sodium being attended with the production of heat and light, while in the case of zinc it is often necessary to bring the zinc and mercury together in the presence of dilute acid before they will combine evenly and smoothly. (2) By immersing the metal to be amalgamated in a solution of a salt of mercury. Copper, gold, platinum, and silver can be amalgamated in this way. (3) By reversing the process last described, and bringing mercury in contact with a salt of the metal whose amalgam is desired. The mercury, in certain cases, will partially replace the metal in solution, the portion so replaced combining with the mercury with the production of the desired amalgam. A valuable modification of this method consists in substituting for the metallic mercury an amalgam of zinc or of sodium, the zinc or sodium changing places with the metal in solution. Amalgams of bismuth, calcium, chromium, iridium, iron, magnesium, manganese, osmium, palladium, and strontium may be prepared by the use of sodium amalgam. (4) By electrolysis, the metal whose amalgam is desired being used as the cathode in a solution of a mercurial salt. (The cathode may also be metallic mercury, and the electrolyte a salt of the metal whose amalgam is desired.) This process is in commercial use for the production of sodium hydrate, a solution of sodium chloride (common salt) being electrolyzed with a mercury cathode. The cathode absorbs the sodium with the formation of sodium amalgam, which is subsequently decomposed by contact with water. In practice the process is continuous, a part of the mercury cathode being exposed to the electrolytic bath, while another part is simultaneously exposed to the action of the water.

In the formation of amalgams there is usually but little thermal effect. In the case of sodium and potassium, however, a very considerable amount of heat is evolved; and in the formation of amalgams of bismuth, lead, and tin, heat is absorbed.

There is considerable evidence in favor of the view that many amalgams contain definite compounds of mercury and the other constituent metals. Thus when certain amalgams are heated (say) to the boiling point of sulphur, the excess of mercury present appears to be volatilized, so as to leave a body behind that has a definite chemical composition. In this way Sonza obtained amalgams having the apparent composition Au_8Hg, $Ag_{13}Hg$, $Cu_{10}Hg$, Na_3Hg, and K_2Hg, the last-mentioned being silvery in appearance and crystalline in structure. But it is said that all these amalgams, as well as many others, continue to lose mercury slowly when the temperature is maintained high; and this fact, while not disproving the existence of a definite compound of mercury and the metal, lessens its probability. Amalgams having the composition $CuHg$, $AgHg$, $FeHg$, Zn_2Hg, Pb_2Hg, and $PtHg_2$ have also been prepared by expelling the excess of mercury from amalgams richer in that metal by exposure to a pressure of 70 tons to the square inch.

One of the most interesting amalgams from the standpoint of chemical theory is the amalgam of the hypothetical radical "ammonium," which is described under AMMONIA.

The affinity of mercury for gold is put to practical use, in mining, for the recovery of small particles of gold from auriferous gravel or crushed quartz. The details of the process vary somewhat according to the nature of the material from which the gold is to be extracted; but in general it may be said that the pulverized gold-bearing quartz or gravel is washed, in a finely divided state, over a plate of amalgamated copper, to which the gold particles adhere. From time to time the gold amalgam is scraped from the copper plate, and more mercury is added. The presence of sulphur (from pyrites) seriously interferes with this process, by causing the formation of a sulphid of mercury which destroys the efficiency of the amalgamated plate. The mercury is then said, in miners' parlance, to become "sick." To prevent this, the ore, if originally rich in pyrites, is roasted to expel the sulphur before being submitted to amalgamation. See GOLD.

Mirrors are silvered by amalgams. One of the simplest of those so used is composed of 1 part of tin to 3 of mercury. A superior amalgam for this purpose contains 2 parts of bismuth, one part each of lead and tin, and 4 parts of mercury. In dentistry the "silver filling" used for closing the cavities in teeth is an amalgam. Its composition varies somewhat, but a preparation containing 2 parts of mercury and 1 part of pulverized zinc gives excellent results. It hardens quickly, and expands slightly in solidifying, thus filling the cavity tightly. Amalgams of copper, silver, lead, and tin have a volume smaller than the sum of the volumes of their constituents. See BATTERY.

Amana, Iowa, a town in Iowa co., 28 m. W. of Iowa City, the site of a German communistic religious colony founded in 1885. It includes the seven villages of Amana, the oldest and largest; East Amana; Middle Amana; High Amana; West Amana; South Amana; and Homestead. The society is governed by a president and a board of 13 directors, and each village is controlled by seven or more elders appointed by the board of directors. Family life is kept up, but in every village are from four to sixteen "kitchen-houses" where meals are prepared and served. The community owns and operates woolen, flour, and saw mills, dye shops, machine shops, and other industrial establishments, and agriculture is extensively followed. The inhabitants dress plainly and in sober colors. The community is primarily a religious organization, and the sect itself dates its founding from Eberhard Gruber, in Würtemberg, in 1714. By its members it is known as "The Community of True Inspiration." Pop. (1901) 1,767.

Amanita, a genus of fungi nearly related to the genus *Agaricus*, to which the common mushroom belongs, and for which two of its poisonous members (see below) are sometimes mistakenly eaten. *A. muscaria*, the fly mushroom, so called from its use as a decoction in milk for killing flies, is commonest in the birch, beech, and pine woods of Europe and America. It has a variously colored cap — white, yellow, orange, red, etc.— usually warted above and sometimes four or more inches in diameter; white or occasionally yellow gills; and a long white stem with bulbous base. Though universally considered poisonous it is said to be used by certain Old World peoples to produce a kind of intoxication. *A. phalloides*, death-cup, deadly agaric, deadly amanita, is commonly found in woods, especially in damp weather, from early summer until mid-autumn. It is usually white, sometimes light yellow or grayish; its cap is seldom as large as four inches in diameter; its gills white; its stem hollow and slender above, solid and bulbous at the base, which is surrounded by a cup which has suggested one of its common names. *A. verna*, a supposed variety of *A. phalloides*, which it greatly resembles, appears in spring and summer. With reasonable caution on the part of the collector none of these species should be mistaken for the common mushroom, because all three grow singly in woods and have white gills and white spores; whereas the mushroom grows in clumps in pastures and upon lawns, occasionally in grassy open woods. Its gills are pink in young specimens and darker in old ones; its spores dark-colored and it has no cup at the base of the stem.

Aman'itin, a strongly basic ptomaine (or perhaps leucomaine) occurring in the poisonous fungus *Amanita muscaria* (*Agaricus muscarius*), or fly agaric. Amanitin is not poisonous, but is converted by oxidation into muscarin (q.v.), to which the deadly effects of the fly agaric are due. Amanitin is believed to be identical with cholin, neurin, and sincalin. See NEURINE.

Amapa'la, a seaport of Honduras on the north shore of the island of Tigre, in the bay of Fonseca. It has an excellent harbor and carries on an important exporting trade. It was founded in 1838. Pop. 1,100.

Amaranthus, the typical genus of herbaceous plants of the natural order *Amaranthaceæ*. This order consists of apetalous plants chiefly inhabiting tropical countries, and remarkable for the white or reddish scales of which their flowers are composed. These preserve their appearance after they are plucked and dried, and on this account poets make the plant an emblem of immortality. The name is from the Greek, meaning "not withering," and was originally *Amarantus*. The natural order contains about 500 species, some of which, as love-lies-bleeding, prince's feather, and cockscomb, are common garden plants. In the wild state they are mostly troublesome and unsightly weeds, of which the tumbleweed (*A. albus*) and pigweed are well-known American examples. Some of the foreign plants are cultivated as pot herbs, and others for their medicinal properties. Their chief commercial value is as decorative plants, for which purpose immense quantities are used in the southern parts of Europe, where they are employed to ornament the churches when fresh-grown blooms are not procurable. Plants of this order are almost entirely annuals.

Amarna Letters, a collection of several hundred cuneiform clay tablets discovered in 1887 at Tel-el-Amarna, a village on the Nile in Middle Egypt, on the site of a city built by Amenophis IV. They comprise the correspondence of the Egyptian court about 1400 B.C., and with but three exceptions are in the Babylonian language. Some of them were written by

Amenophis III. and Amenophis IV., and other royal personages contemporary with these, but the majority are by Egyptian officials and allies in Syria. Their discovery has thrown much light not only on the history of Egypt itself, but upon the condition of the Holy Land prior to the Hebrew invasion. An English translation of the letters, by Metcalfe, with the title 'The Tel-el-Amarna Letters,' appeared in 1896.

Amaryllidaceæ, or **Amaryllideæ,** a natural order of monocotyledonous plants, generally bulbous, sometimes fibrous-rooted, occasionally with a tall, cylindrical, woody stem. Their characteristics are a highly-colored flower, six stamens, and an inferior three-celled ovary. They are natives chiefly of the Cape of Good Hope; but species are found in the warmer parts of Europe, in every part of America and tropical Asia, and a few species in Australia. To this order belong the snowdrop, the snowflake, the daffodil, the belladonna-lily, the so-called Guernsey lily (probably a native of Japan), the Brunsvigias, the bloodflowers (Hæmanthus) of the Cape of Good Hope, different species of Narcissus, Amaryllis, Galanthus, Crinum, Agave (American aloe), Atamasco lily, star-grass, spider lily, etc.; many of the family are very poisonous. The agave and sisal (q.v.) are of considerable commercial value, but the order as a whole is chiefly ornamental.

Amaryllis, the name of a shepherdess in the Theocritean 'Idyls' and the Virgilian 'Eclogues'; also of a character in Spenser's 'Colin Clout's Come Home Again'; of the shepherdess in love with Perigot, in Fletcher's pastoral 'The Faithful Shepherdess'; and of a character in Buckingham's comedy 'The Rehearsal.'

Amasa (more correctly **Ammishai),** the nephew of David, king of Israel. He was commander-in-chief of Absalom's rebel army, and after its defeat received from David a promise of the same post in his own army in place of Joab. On the renewal of the revolt under Sheba, Amasa was assigned the task of collecting the men of Judah; as he did not appear when due (perhaps knowing too much about the disturbance), Abishai was sent in his place, and Joab's company took part without commission. Amasa met them at Gibeon, and under pretense of a salute Joab stabbed his cousin and rival (2 Sam. xx. 9).

Ama'sia, a city in Asiatic Turkey, province of Anatolia, 335 m. E. of Constantinople, famed as the ancient capital of Pontus and as the birthplace of the historian Strabo. It is built almost entirely of stone and contains a massive citadel and a notably fine mosque. Silk is made here, and salt, wine, wheat, and cotton are also exported. Pop. about 30,000.

Ama'sis I., an Egyptian king, the first monarch of the 18th dynasty. His rule lasted for some 20 years following 1600 B.C. He expelled the Shepherd Kings from Egypt and laid Palestine and Phœnicia under tribute.

Amasis II., an Egyptian king: b. 570; d. 526 B.C. He cultivated friendly relations with the Greeks, and established Greek commerce at Naucratis. Pythagoras and Solon are said to have visited him. He greatly enriched Memphis.

Amateur. Up to the middle of the 19th century this now ever-recurring word was used exclusively to define those who for the love of the arts, and not for the profit to be derived from the exercise of them, painted, or engraved, or sang. In such of the recreations and sports as were then in vogue, and which some men engaged in for pleasure and others for pay, the phrase used to distinguish the two classes varied. If a man of means rode a horse in a race or a steeplechase for the pure love of equestrianism, while others rode for fees, the one was called a "gentleman rider," and the rest were "jockeys." So again in cricket, those who participated in matches were designated by two titles: "gentlemen," denoting those who participated *con amore*, and "players," those who played for pay. It was always easy to recognize one from the other, for in the list of published names one class was always designated "Mr.," as "Mr. Somerville," while the "players" would lack that prefix and appear as "Thomas Sadler."

Golf of that period was more democratic; neither the word amateur nor any other distinguishment had appeared; cobbler and prince played together, and for stakes too, without a thought of one or the other losing caste. James II., king of England, while still Duke of York, chose an Edinburgh shoemaker as his golfing partner to play two Scotch peers for a goodly stake of money which he and the cobbler won. The prince did the honorable thing by giving up his half of the stake to the shoemaker, with which and his own share the latter bought a house in the Cripplegate of the city.

Football at that period was largely in abeyance, except among schoolboys, and the need of definitions had not arisen.

The word amateur in sports first appears in connection with rowing. Up to the year 1835 such rowing contests as had taken place had been on the one hand confined to watermen, who at that time had to serve apprenticeships and could not ply their trade without: and on the other hand to inter-collegiate and inter-university crews. Neither class needed definitions. But at that time an open regatta was organized at Henley, in which it would have been manifestly unjust to allow watermen and others who had had a lifetime's experience and of hardened training to enter and compete against those for whom the regatta was really intended, that is, those who loved aquatic sport for its own sake and followed it only as a recreation at seasonable times. Hence rules were formulated and have ever since been in operation which distinguished the professional from the amateur and precluded the possibility of the one contesting against the other. So strong is this feeling still in rowing at Henley that in 1902 a further restriction was made against the entry of any crew that had within a month from its entry been trained by a professional.

When track athletics, about 1850, first crystalized by the impulse given it by colleges and clubs, similar conditions existed. The only representative of this form of recreation at that time was the old and hardened trotter-around-the-track, sometimes for the gate money derived from it, sometimes for the benefit of the betting men. Ostensibly it would have been unfair to handicap young collegians by

permitting their intermingling, even if for ethical reasons it had not been desirable. Rules were here again formulated which had the effect of barring the professional and defining the amateur. The rule of the Amateur Athletic Association of Great Britain may be quoted as expressing the then prevalent feeling:

"An amateur is one who has never competed for a money prize or staked bet, or with or against a professional for any prize, or who has never taught, pursued or assisted in the practice of athletic exercises as a means of earning a livelihood."

Football added another temptation on account of its possibilities in city centres of attracting large numbers and much gate money. Here, too, the barrier was raised, in both the association and the Rugby games, along lines which America has followed. But the United States authorities in all recreations have gone a great deal farther in the strictness of their definition of the word amateur, and in safeguarding against persons who receive any portion of their traveling or hotel expenses: a notable example of this occurred in 1902, when the National Golf Association precluded from the amateur ranks any player who participated in the generosity of railroad companies or hotel proprietors.

It would seem an easy thing, from the foregoing facts, to be able to formulate a phrase which should generically and yet accurately describe an amateur, but it is not, as the story of the endless definitions adopted and abandoned, or amended, though made by experts, attests.

The spirit is the old spirit "for the love of the art or game and not for personal gain"; even if a present literal definition were attempted, it might be rendered obsolete by new legislation in a short time. Those who are purposing to enter any particular recreative contest in which the status of the amateur is material must consult the last rules of the organization governing it.

Ama'ti, an Italian family of Cremona, celebrated for their skill in making violins. ANDREA AMATI (b. about 1520; d. 1570) was the earliest member to follow the art, but few of his instruments remain. His younger brother, NICOLA, made basses. Andrea's sons, ANTONIO (b. about 1555) and GERONIMO (b. 1556; d. 1630), worked after their father's manner, but Geronimo's son NICOLO (b. 3 Dec. 1596; d. 12 Aug. 1684) excelled all others of his family, and in his hands the art of the Cremonese school reached its perfection. His most famous pupils were Antonio Stradivarius and Guarnari. The line ended with his son GERONIMO, whose violins were of inferior quality.

Amatitlan, or **Amatitan**, a Central American town in the republic of Guatemala, 20 m. S.W. of Guatemala City. The houses are low and built of mud. There are hot springs in its vicinity and salt and alum wells also. The occupation of the people consists chiefly in the production of cochineal. Pop. about 8,600.

Amaurosis, a disease of the retina or its nervous connections, resulting in partial or complete blindness. It usually begins with confused vision; there may then be the appearance of a black spot in the centre of an object looked at, and graded dimness of sight develops. See AMBLYOPIA.

Amau'ry I., a king of Jerusalem: b. 1135; d. 11 July 1173. He was the son of Baldwin II., and reigned from 1168 to 1173, in succession to his brother, Baldwin III.

Amau'ry II., sometimes known as **Amau'ry de Lusignan**, titular king of Jerusalem: b. 1144; d. at Acre, 1205. He was king of Cyprus 1194–1205, succeeding his better known brother, Guy de Lusignan.

Amaxichi, or **Leokas**, a Greek town, the capital of Santa Maura, or Leucadia, one of the Ionian Islands. A Greek archbishop resides here. It is on the E. coast of the island and possesses a small harbor. Pop. 6,000.

Amazi'ah, king of Judah about 797–779 B.C.; son of Joash. He punished his father's murderers and reconquered the Edomites; but according to 2 Kings xiv. was so puffed up by his victory over these Bedouin that he challenged Joash, king of Israel, an incomparably more powerful, civilized foe, to a war. Joash retorted with stinging contempt, wishing to avoid the contest, but Amaziah insisted, and Joash routed his army and captured him, stormed and sacked Jerusalem, destroyed a part of the wall, and carried away to his capital of Samaria hostages, and a large amount of spoil, including gold and silver treasure and temple utensils. Amaziah, after his release and 15 years further of reign, was killed by conspirators at Lachish (2 Kings xiv. 19).

Am'azon, a river of South America, once called the Orellana after its Spanish explorer. Its source is found in the Peruvian Andes, its headwaters, the Marañon and Ucayale rivers, uniting in about lon. 74° W. From lon. 70° its course is wholly in Brazil, and its entire course from the source of the Ucayale to its mouth is about 4,000 miles, its width increasing from over a mile at the Peruvian frontier to 150 miles. The Amazon receives the waters of about 200 tributaries, 100 of which are navigable, and 17 of them 1,000 to 2,300 miles in length. From the north it receives the Santiago, Morona, Pastaza, Tigre, Napo, Putumayo, Japura, Rio Negro (a branch of which, the Cassiquiare, strangely enough connects it with the Orinoco), Uatama, Trombetas, etc.: from the south the Huallaga, Ucayale, Yavari, Jutahy, Jurua, Teffé, Coary, Purus, Madeira, Tapajos, Xingu, etc. The depth varies much. From the sea to the mouth of the Rio Negro, about 750 miles in a straight line, the depth is nowhere less than 30 fathoms; higher up it varies from 10 to 12, and up to the junction of the Ucayale there is depth sufficient for the largest vessels. The rapidity of the stream is considerable, especially during the rainy season (January to June), when it is subject to great floods, being on the average 2¾ miles per hour; in some places it is 4, or even more, and in others as low as 1 mile. The river is perceptibly affected by the tides up as far as the town of Obidos, 400 miles from its mouth. The phenomenon of the *bore*, or as it is called on the Amazon the *pororoca*, occurs at the mouth of the river at spring tides on a grand scale. The waters of the ocean rush into the river in the form of huge waves 10 to 15 feet in perpendicular height, three or

four of which follow each other with irresistible force. The waters of the Amazon swarm with alligators, turtles, and a great variety of fish, of which Agassiz in 1866–7 discovered 1,163 species. The country through which it flows is covered with immense and impenetrable forests, affording homes for a vast variety of animals, including birds of the most gorgeous plumage. The area drained by the Amazon and its tributaries is estimated at 3,000,000 square miles. This region produces an immense variety of vegetable substances, including a great many drugs, dyewoods, and valuable timber trees. The products it might be made to yield by cultivation are almost innumerable, among the chief being cotton, sugar, indigo, coffee, cocoa, and tobacco. The Amazonian water system affords some 16,000 miles of river suitable for navigation. Steamers began to ply on the river in 1853, and latterly the navigation was opened up to all nations. Pará is the chief seat of the trade on the river, and Manáos, situated about 1,000 miles up, is also a place of active trade. About 40 river, coasting, and ocean steamers now ply regularly between Pará and Manáos every month, a number of them being British. The mouth of the Amazon was discovered by Yañez Pinzon in 1500, but the stream was not navigated by any European till 1540, when Francis Orellana descended it. The river has been explored in later times by La Condamine (1743-4), Humboldt (1799), Prince Adalbert of Prussia (1842), Herndon (1850), Avé Lallemant (1858), Bates (1861), Marcoy (1866), Agassiz (1866-7), and others; and its tributaries by Hartte, Chandless, Abendroth, etc. See Herndon, 'Exploration of the Valley of the Amazon' (1853); Bates, 'The Naturalist on the River Amazons' (1864); Wallace, 'Narrative of Travels on the Amazon and Rio Negro' (1870; second edition, 1889); Matthews, 'Up the Amazon and Madeira Rivers' (1879); Guillaume, 'Amazon Provinces of Peru' (1888); Schutz-Holzhausen, 'Der Amazonas' (1895). See SOUTH AMERICA.

Amazo'nas, or **Alto Amazona**, the largest of all the Brazilian States and the farthest north: bounded N. by Dutch and British Guiana and Venezuela; E. by the State of Pará; S. by Bolivia and the State of Matto Grosso; W. by Colombia, Ecuador and Peru. Its area is 732,-460 sq. m., or nearly three and a half times that of France, and except for mountain ranges on the Venezuelan border it is an alluvial plain. Its capital is Manaos. Population of the State (1900) 207,600. (See Temple, 'The State of Amazonas.') The name Amazonas is also borne by a territory of Venezuela with a population of about 20,000, and a department of Peru with a population of about 35,000.

Am'azons, in Greek legends a nation of female warriors. They were fabled to have cut off their right breasts in order not to interfere with their use of the bow, and variously to have expelled men from their country or kept them in subjection for the continuance of the race. The earliest traditions locate them in Asia Minor, and relate their appearance at the siege of Troy under their queen Penthesilea.

Amazonstone, a beautiful green or blue feldspar. It is a variety of the mineral microcline and occurs in magnificent crystals in granite near Pike's Peak, Col. Inferior crystals occur in New Jersey, the Ural Mountains and many other localities. Large quantities of green, cleavable amazonstone have been obtained at Amelia, Va., and have been worked up as semi-precious and decorative stones.

Ambala, or **Umballa**, the name of a district of N. India and its capital. The latter was the scene of a treaty between the governor-general of India, Lord Mayo, and the Emir Shere Ali of Afghanistan in 1869. The town contains several important churches, a dispensary, hospital, and a leper asylum. Pop. 80,000.

Ambale'nia, Colombia, a city in the department of Tolima, on the Magdalena River, 50 m. W. of Bogota. It is the trade centre of a rich agricultural region, exporting large quantities of excellent tobacco. Pop. 8,500.

Ambari Hemp. See HIBISCUS.

Ambarv'alia, a Roman festival in honor of Ceres, which was observed in May. The blessing of the goddess was then besought on the wished-for harvest.

Ambassador (from the Mediæval Latin *Ambasciator*, an agent), a diplomatic officer of the highest rank, the representative of one nation at the court of another. In this capacity he is expected to support the interests and dignity of his own State. Ambassadors are ordinary when they reside permanently at a foreign court, or extraordinary when sent on a special occasion. When ambassadors-extraordinary are vested with full powers, as of concluding peace, making treaties and the like, they are called plenipotentiaries. Ambassadors are often loosely styled ministers. Envoys are ministers employed on special occasions, and are of less dignity than ambassadors. Until 1893 the United States had been represented at foreign courts by persons with the rank of ministers-resident, accredited in the care of the great powers as envoys-extraordinary and ministers-plenipotentiary. In that year, however, an act of Congress was passed allowing the President to accredit ambassadors as United States representatives at several of the more important European courts. When acknowledged as such, ambassadors are exempted absolutely from all allegiance and from all responsibility to the laws of the country to which accredited. Should they be so regardless of their duty, however, and of the object of their privilege, as to insult or openly to attack the laws of the government, their functions may be suspended by a refusal to treat with them, or application can be made to their own sovereign for their recall; or they may be dismissed and required to depart within a reasonable time. An ambassador is considered as if he were out of the territory of the foreign power, by fiction of law, and it is an implied agreement among nations that the ambassador, while he resides in the foreign state, shall be considered as a member of his own country, and the government has exclusive cognizance of his conduct and control of his person. Ambassadors' children born abroad are held not to be aliens. (7 Coke, 18 *a.*) The persons of ambassadors and their domestic servants are exempt from arrest on civil process. (3 Burr. 401, 1731.)

Amba'to, a town of Ecuador, on the slope of Chimborazo, 70 m. S. of Quito. It has a flourishing trade in grain, sugar, and cochineal. Pop. 12,000.

Amber, one of the most important and valuable of the fossil resins. It is one of the oxygenated hydrocarbons and its mineralogical name, succinite, emphasizes one of its distinguishing characteristics, namely, the presence of from 5 to 8 per cent of succinic acid. Its composition is represented by the formula $C_{40}H_{64}O_4$. It occurs in irregular masses, usually of small size but sometimes weighing up to 15 or 18 pounds. It has a yellow color, resinous lustre and conchoidal fracture. Its hardness is 2 to 2.5 and specific gravity 1.05 to 1.1. Along the shores of the Baltic Sea, especially in East Prussia, mining for amber has been carried on for two centuries. In this region shafts are sunk through a superficial stratum of marl and sand, a bed of lignite with light sands and gray clays, and finally a layer of green-sand, 50 to 60 feet thick.

All of these strata contain amber, but in the lower portion of the green-sand there is a stratum 4 to 5 feet thick of «blue earth» in which amber nodules occur so abundantly that 50 or 60 square rods yield several thousand pounds. This «blue earth» stratum extends out under the sea and there the amber is freed and cast upon the shores by the waves, especially after the autumnal storms. Numerous other localities are known, but none are so prolific. In the United States amber-like resins have been found in the green-sand formation of Martha's Vineyard, Harrisonville, N. J., and elsewhere.

Pliny declared amber to be «an exudation from trees of the pine family,» a conjecture that proves to be correct. The fact that it was at one time fluid or nearly so is established by its occasional inclusion of insects; and its antiquity is also established by the fact that most of the species of insects so included are now extinct.

Amber becomes strongly electrified when rubbed, and the power that it then possesses, of attracting light bodies to itself, was probably considered by the ancients to be the outward sign of the mysterious virtues that they attributed to the mineral. It was greatly esteemed for ornaments and charms, and Pliny says that among women «it had been so highly valued as an object of luxury that a very diminutive human effigy, made of amber, had been known to sell at a higher price than living men, even in stout and vigorous health.» He also says that a necklace of amber beads was considered to protect the wearer from secret poisons, and to be efficacious as a counter-charm against sorceries and witchcraft. In the time of Nero an expedition sent from Rome to the Prussian amber-beds returned with 13,000 pounds of the precious substance.

In modern times amber is chiefly used for the manufacture of mouthpieces for tobacco pipes and for the preparation of a kind of varnish. The attractive power exhibited by amber when rubbed was the first electrical phenomenon observed by man, and the word «electricity» was derived from *electrum*, the Greek name for amber.

Amber-fish, any one of a genus of fishes (*Seriola*) related to the pilot-fishes, many species of which are found along our coasts, the most of which are known by other names. The great amber-fish, or amber-jack, is a food-fish of some importance in the Gulf of Mexico and the West Indies, reaching a weight of 100 pounds. Others in that region are more commonly known as madregals; and a species of the Pacific Coast is the highly-prized yellow-tail (q.v.). The name refers to the prevailing color.

Am'berg, the ancient Bavarian capital of the upper Palatinate, is situated on both sides of the Vils, in the midst of numerous iron-works. It is well built, and on the site of its former walls are shaded walks. Glass, iron wares, stoneware, tobacco, beer, vinegar, and arms of good quality are manufactured here. The principal buildings are a Gothic church of the 15th century, the royal palace, the town-house, and the Old Jesuits' College, and it possesses a gymnasium and a large library. At Amberg the Archduke Charles defeated the French general, Jourdan, on 24 Aug. 1796. Pop. (1900) 22,000.

Amber Gods, The, a story by Harriet Prescott Spofford, published 1863. It is characterized by superb depth and richness of color, like a painting by Titian. An amber amulet or rosary possessing mysterious influences gives the title to the story.

Am'bergris, a gum-like substance of great value in the making of perfumes, obtained from the intestinal canal of the sperm whale, or found floating in pieces of various sizes on the surface of the sea. It is a product of cetacean digestion, and often contains the beaks of cuttle-fish, a fact which conclusively proves the place of its origin, until recently much in doubt. When first extracted from the alimentary canal it has the feeling and consistency of thick grease, and chemically seems to be of the nature of cholesterin, but after exposure to the air hardens and acquires its characteristic sweet earthy odor. Some odd stories were told by the old writers to account for its origin, of which the least absurd was that it was the excrement of the whale. It was held by the ancients to be of great value in certain diseases, but is now used entirely in connection with perfumery, and is worth about $20 a pound. The name is also given to a barren island on the coast of Yucatan, on account of the quantities of ambergris gathered along its shores.

Amber Insects. The great majority of the fossil insects of the Oligocene (Tertiary) period have been obtained from the amber of the Baltic shores of Prussia, upon which they had rested in life, stuck fast and then been overflowed. The most fragile and delicate flies, moths, and many other insects, besides spiders, mites, centipedes and crustacea, are preserved in this gum or resin, which was evidently formed in the same manner as gum copal, also a late tertiary or quaternary gum.

Ambitious Woman, An, a novel by Edgar Fawcett (1883). It is a keen yet sympathetic analysis of an American female type whose dominant trait is social ambition. Claire Twining is reared in the ugly poverty of a Brooklyn suburb, but is clever and capable, with strong aspirations for the luxuries of life. Through the good offices of a schoolmate she gains a social foothold. If Claire's transformation seems a little sudden, there is genuine strength in the story and much truthful observation of city life in New York.

Ambler, James Markham Marshall, surgeon and Arctic explorer: b. Virginia, 30 Dec. 1848; d. in the Lena Delta, Siberia, 31 Oct. 1881. Educated at Washington and Lee University and the Medical College of the University of Maryland, he practiced medicine in Baltimore 1870–4; entered the navy as assistant surgeon 1874; and was selected as volunteer for that post to the Jeannette arctic expedition under George W. De Long, 1879. When their vessel sank, 13 June 1881, he accompanied his chief along the Lena and was alive at the date of the last entry in De Long's journal, 30 Oct. 1881, but probably died the following day. His remains were discovered by Chief Engineer Melville 23 March 1882. Upon his body were found memoranda on 'Ice Formed by Sea Water,' and 'Remarks on Snow Crystals,' published in De Long's 'Journal' (Boston 1883).

Ambleside, a town in the English lake district, Westmoreland, the home of Harriet Martineau, and near which Wordsworth and Dr. Arnold resided. The chief industry is the manufacture of coarse woolen goods. Pop. (1901) 2,536.

Ambleteuse, a French village on the English Channel 6 miles north of Boulogne, noted as the landing-place of James II. on his flight from England 1689. In 1805 Napoleon erected a monument here to the Grand Army. Pop. (1901) 685.

Amblydactyla. See AMBLYPODA.

Amblygonite, am-blig'ō-nīt (from the Greek *amblygonios*, "obtuse-angled"), a mineral crystallizing in the triclinic system, and having the chemical formula $AlPO_4.LiF$. The lithium is often partially replaced by sodium, and the fluorin by hydroxyl (OH). Its hardness is 6, and its specific gravity about 3.05. It is translucent and white, or more or less tinged with various colors. It occurs in certain localities in Saxony, Norway, France, and Peru; and in the United States it has been found in Maine and Connecticut. It is a valuable lithia ore.

Amblyopia, defective, weak, or blunted vision, a word now widely employed instead of the term amaurosis, meaning blindness (q.v.), since the modern methods of examination of the retina have made known the more exact character of the affections of this part of the eye. Defective, weak, or blunted vision due to disorder of the retina usually may be attributed to the following main causes: (1) certain poisons, notably alcohol, wood alcohol in particular, tobacco, lead, and uræmic poisoning of Bright's disease; (2) certain functional or reflex disturbances, as in hysteria; (3) changes in and about the optic nerve, as pressure of inflammations, or of tumors, leading to optic neuritis; (4) cerebral changes, such as hemorrhages, tumor of the brain, localized injury of the brain, usually leading to localized types of amblyopia (hemianopsia); (5) defective cerebral development, causing congenital amblyopia.

Amblyop'sidæ, a family of fresh-water fishes closely allied to the cyprinodonts and remarkable for living altogether in caves, except one species found in the ditches of the rice-fields of South Carolina. Among many peculiarities may be noted the facts that the vent is at the throat instead of in the usual position behind the ventral fin, and that all of the underground species are blind. See CAVE-DWELLING ANIMALS.

Amblypo'da, an extinct order of hoofed mammals found in the Eocene formations of North America and Europe. They are distinguished by a primitive pattern of teeth and short post-like feet resembling those of elephants. The chief types are Pantolambda, Coryphodon and Uintatherium (qq.v.).

Amblys'toma, a genus representing a subfamily (*Amblystomatinæ*) of salamanders of North and Central America, and northern Asia. The parasphenoid bone is toothless. A common American species is the spotted salamander (*A. tigrinum*) whose young in certain Mexican lakes never reach the adult condition, and are known as "axolotls." See AXOLOTL; SALAMANDER.

Am'bo, a reading-desk or pulpit, which in early churches was placed in the choir. The epistle and gospel were read from the ambo, and sermons sometimes preached from it. It had two ascents — one from the east and the other from the west. In many churches there were two ambos, one on each side of the choir, from one of which the gospel was read, and from the other the epistle. The earliest are at Ravenna in the cathedral and the Church of Saint Apollinare, and are of carved marble. (See PULPIT.) The name ambo was also given to an eagle-shaped reading-desk, now usually termed a lectern.

Amboise, am'bwäz, **Aimeric d',** a famous French admiral, brother of Georges d'Amboise (q.v.); d. 1512. He became in 1503 Grand Master of the Knights of St. John in Rhodes, and gained a great victory over the Sultan of Egypt in 1510.

Amboise, Bussi d'. See BUSSI.

Amboise, Georges d', a French cardinal and minister of state: b. at Chaumont-sur-Loire 1460; d. 1510. He became successively bishop of Montauban, and archbishop of Narbonne and of Rouen, and in 1498 Louis XII. made him prime minister. He failed in his attempt to secure the papacy, but his policy toward France was wise and statesmanlike. He reformed the Church, remitted the people's burdens, and conscientiously labored to promote the public happiness.

Amboise, a French town in the department of Indre-et-Loire, on the Loire, 15 miles by rail east of Tours. It lies in a rich vineyard district and has been called "the Garden of France." The town is memorable as the scene of the conspiracy of the Huguenots against the Guises (1560). It contains a beautiful chateau dating from the time of the Renaissance. Pop. (1901) 4,600.

Amboy'na, or **Amboina,** the most important of the Molucca Islands, being the seat of their government and the centre of the commerce in nutmegs and cloves; greatest length, 33 miles; greatest breadth, 10 miles; area, about 260 square miles. It is composed of two unequal peninsulas united by an isthmus about a mile broad, the larger known as Hitu, the smaller as Leitimor. Its general aspect is attractive and its climate salubrious. It is covered almost throughout with forests, affording

a great variety of beautiful wood for inlaying and ornamental work. Sugar and coffee are cultivated. The surface is generally rugged and hilly, sometimes rising into mountains of granite. The soil in the valleys and along the shores is very fertile, but a large portion remains uncultivated. In 1605 Amboyna was taken by the Dutch from the Portuguese, and shortly afterward some English factories were erected there; but in 1623 the Dutch seized the English fort, tortured frightfully Capt. Towerson and nine others to obtain a confession of conspiracy, and put them to death — a performance famous as "The Massacre of Amboyna." Pop. 30,000. Amboyna is also the name of one of the residencies into which the Molucca Islands are divided, including Buru, Caram, Aru Islands, the Bandas, and others. Pop. 95,000.

Amboyna, the capital of the Dutch residency of that name situated on the northwest shore of the peninsula of Leitimor and defended by Fort Victoria. The houses, built in Dutch fashion, are generally of one story, owing to the frequency of earthquakes, one of great severity occurring in January 1898. It contains a governor's palace, town-house, two Protestant churches, several mosques, an orphan hospital, a theatre, and a large covered market-place. The streets are wide, and are planted on each side with rows of fruit-trees. Pop. about 10,000.

Ambriz, äm-brēj', a seaport, capital of a district of the same name in the Portuguese colony of Angola, west Africa. Originally the capital of Quibanza it was taken by the Portuguese, who in 1855 built a fort, a custom-house, and a church which formed the nucleus of the present town. It has a number of factories and a trade in india-rubber, coffee, and palm oil. Pop. about 3,000.

Ambros, äm'brōs, **August Wilhelm,** a notable Austrian writer on music: b. 17 Nov. 1816 in Mauth, Bohemia; d. Vienna 28 June 1876. He was trained for the civil service and served in it with distinction; but his tastes led him elsewhere, and he rose to eminence as the author of 'The Limits of Music and Poetry,' besides numerous essays and studies connected with art. His masterpiece, 'The History of Music' (1862–8) a work which cost him many years of labor, was carried only to the fourth volume. A fifth, completing the work, was added by Langhaus.

Ambrose, Saint, a celebrated Latin father of the Church: b. 333, or according to other accounts, 334, probably at Treves (the ancient Augusta Trevirorum), where his father resided as pretorian prefect of Gallia Narbonensis; d. Milan, 4 April 397. It is told that a swarm of bees covered the eyes of the boy while slumbering in the court of his father's castle, and the nurse was astonished to perceive the bees going in and out of his mouth without doing him any injury. His father, possibly recalling a similar wonder, mentioned of Plato, prophesied future greatness for his son. Ambrose studied law at Rome under Anicius Probus and Symmachus, and then went to Milan and began to plead causes while yet a youth. His pleadings were so eloquent and skilful that in a short time Probus, the prefect of Italy, chose him a member of his council; and in 369, with the approval of the Emperor Valentinian, appointed him governor of the provinces of Liguria and Æmilia (North Italy). In 374 he was called to the bishopric of Milan by the unanimous voices of Arians and Catholics. Ambrose long refused to accept this dignity, but in vain. He fled by night, and thought himself on the way to Pavia, but unexpectedly found himself again before the gates of Milan. At length he yielded, received baptism, for he had hitherto been only a catechumen, and eight days after was consecrated a priest. The 7th of December is still celebrated by the Church on this account. On his elevation to the bishopric he bestowed all his wealth on the Church and among the poor, resolving to live as simply as possible, and at the same time to exercise his functions as an ecclesiastical ruler with firmness and vigor. He was employed by the court to negotiate with Maximus, then threatening Italy, whose advance he succeeded for a time in arresting (383). Four years later he was sent on a like mission, but his conduct on this occasion so offended Maximus that he had to return to Milan, having accomplished nothing. In his struggles against the Arian heresy he was opposed by Justina, mother of Valentinian II., and for a time by the young emperor himself, together with the courtiers and the Gothic troops. Backed by the people of Milan, however, he felt strong enough to deny the Arians the use of a single church in the city, although Justina, in her son's name, demanded that two should be given up. He was commanded to quit the city, but this he refused to do, being still supported by the people. About this time Ambrose, instructed by a dream, searched for and found the relics of two martyrs, Gervasius and Protasius. The people crowded to see these bones, and, according to Ambrose himself, the eyes of the blind were opened and devils were cast out by touching them. Although the court derided these miracles they were accepted by the people, and the triumph of orthodoxy was secured. He had also to oppose paganism. In 390, after the massacre at Thessalonica, he refused the Emperor Theodosius entrance into the church of Milan for a period of eight months, only restoring him after a public penance. (See THEODOSIUS.) The later years of his life were devoted to the more immediate care of his see. His writings (the best edition is by the Benedictines, two vols. folio, 1686–90), bear marks of haste, and show his theological knowledge to have extended little beyond an acquaintance with the works of the Greek fathers, from whom, especially Origen, he borrowed considerably. The "Ambrosian Chant" or "Te Deum Laudamus" has been ascribed to him, but was written a century later. He may be considered the father of the hymnology of the Latin Church. He is the patron saint of Milan, which observed his 15th centenary in 1897.

Ambro'sia, in the Greek mythology, a balsamic juice which formed the food of the gods and preserved their immortality. It was used also as an ointment. Mortals permitted to partake of ambrosia received an increase of beauty, strength, and swiftness, becoming in some measure assimilated to the gods.

Ambrosia Beetle. See WOOD-BORING BEETLES.

Ambrosian Chant. See GREGORIAN CHANT.

Ambrosian Library, public library in Milan; founded by the Cardinal Archbishop Federigo Borromeo, a relation of St. Charles Borromeo, and opened in 1609. It now contains over 175,000 printed books and 8,400 MSS.

Amelan'chier, a genus of shrubs or small trees of the natural order *Rosaceæ,* natives of Europe, Asia, and America. The species, which are few in number and closely related, have alternate, simple, deciduous leaves, numerous racemes of white showy flowers appearing in early spring often before the leaves, and, in summer, edible spherical or oblong red or dark purple berries with more or less bloom. They are ornamental, hardy, succeed upon many soils and in many climates, and are readily propagated by seeds or suckers.

Amélie-les-Bains. See ARLES.

Amendment, in law, the correction of any mistake discovered in a writ or process. At common law, amendments, in the absence of any statutory provision on the subject, are in all cases in the discretion of the court for the furtherance of justice. The power of amendment is regarded as incidental to the exercise of all judicial power. Amendments are very liberally allowed in all formal and most substantial matters under statutes in modern practice. They are allowed either without costs to the party amending, or upon such terms or conditions as the court may see proper to impose.

In legislative proceedings, a clause, sentence, or paragraph proposed to be substituted for another, or to be inserted in a bill before Congress, and which, if carried, actually becomes part of the bill itself. As a rule amendments do not overthrow the principle of a bill. The Senate of the United States may amend money-bills passed by the House of Representatives, but cannot originate such bills. The Constitution of the United States contains a provision for its amendment. (U. S. Const. Art. 5).

America: a brief account of the derivation and meaning of the word. The name Amalric (in Old High German Amalrich or Amelrich; Gothic Amala-reiks or -reikis; variants Am-el, Am-ul, and Am-il-rih, -rich, or ric) originated among the Goths in Northern and Central Europe; was adopted by other nations of the Teutonic stock before the great migration of those kindred peoples; and was carried into all West European countries — even to England and the Mediterranean coasts — by the Northern conquerors between the fifth and twelfth centuries. The famous East Gothic dynasty of the *Amala* received its name, according to tradition, from a national hero whose mighty labors had earned for him the title *Amal,* which, as we shall presently explain, was a purely democratic term, connoting personal character and achievement, without the slightest implication of social rank.

From the dynastic name, the Goths as a race, or, more narrowly, the East Goths, were familiarly called *Die Amelungen;* the Amal king in the fourth century ruled from the Baltic to the Black Sea; at the beginning of the sixth century a king of the West Goths in Spain and France, a grandson of Theodorich the Great, was called *Amalarich.* The word of democratic meaning thus spread through a few lands was destined to live, in the centuries that followed, united inseparably with the other short word which appears in the name of the West-Gothic king.

The signification of the compound is of extraordinary interest. Its second member appears in Old English (for example, in the Anglo-Saxon epic of Beówulf) as *ric,* meaning *powerful,* or, when a substantive, *control, domain,* or *empire* — the modern German *Reich.* According to von Humboldt ('Examen Critique,' vol. iv) and Professor von der Hagen, the fundamental meaning of the first member (its root, *am,* often occurring in the dialects of Iceland and Scandinavia in the forms *ama, ambl,* etc.) is *labor,* endurance of great toil. Accepting this view, we find that the title of the Gothic national hero, *Amal,* expressed popular appreciation of "the man of great or laborious enterprises." Simply that. In order to show that *Amal,* when uniting with the aristocratic monosyllable, retained its original value, so characteristic of the people who used it every day; that, at least, they never thought it meant "the mighty," as some authorities have asserted recently; we need only point to the facts that they prefixed it to *ric,* which itself signified "mighty," and that folk stories served to remind them constantly of the primitive meaning of the first member. Amalric, then, was the name which compacted the old ideal of heroism and leadership common to all Germanic tribes, the ideal that stands out most clearly in the character of Beówulf — the Amal of Sweden, Denmark, and Saxon England. The compound plainly meant what the North European hero-stories described: The man who ruled because he labored for the benefit of all.

In France, this name was softened to *Amaury.* Thus, a certain theologian who was born in the 12th century at Bène, near Chartres, is called indifferently Amalric of Bène or Amaury of Chartres. England, in the 13th century, could show no more commanding figure than Simon of Montfort-*l'Amaury,* Earl of Leicester, to whom King Henry once said, "If I fear the thunder, I fear you, Sir Earl, more than all the thunder in the world." A Norman *Amalric* was that Earl Simon, creator of a new force, and a democratic one, too, in English politics. "It was," says the historian Green, "the writ issued by Earl Simon that first summoned the merchant and trader to sit beside the knight of the shire, the baron, and the bishop in the parliament of the realm." In Italy, after the Gothic invasion, the Northern name suffered comparatively slight euphonic changes, which can be easily traced. As borne by a bishop of Como in 865 it became *Amelrico* or Amelrigo. But the juxtaposition of the two consonants *l* and *r* presented a difficulty in pronunciation which the Italians avoided: they changed *lr,* first, to double *r,* and then to a single *r.* Still, 600 years after Bishop Amelrigo died, the Florentine merchant, explorer, and author usually retained the double *r* in his own signature, writing "*Amerrigo* Vespucci," and, by the way, accenting his Gothic name on the penultimate (Amerígo, not Amérigo). In Spain the name must have been rare, since it was often used alone to designate the Florentine during his residence in that country. There was, ap-

parently, no other Amerigo or Amerrigo in the Spanish public service early in the 16th century. We must again look toward the North for the scene of the next important change, and among the men of a Northern race for its author.

Martin Waldseemüller, a young German geographer at St. Dié, in the Vosgian Mountains, whose imagination had been stirred by reading Amerigo's account of voyages to the new world, bestowed the name *America* upon the continental regions brought to light by the Florentine. It is not enough to say, with Mr. John Boyd Thacher ('Columbus,' vol. 3; compare also his interesting 'Continent of America'), that Waldseemüller «suggested» this designation. As editor of the Latin work, the 'Cosmographiæ Introductio' (5 May, 1507), he stated most distinctly, with emphatic reiteration, his reasons for this name-giving; placed conspicuously in the margin the perfect geographical name, America, and at the end of the volume put Vespucci's narrative. Further, on a large map of the world, separately published, he drew that fourth part of the earth which was the 'Introductio's' novel feature — marking it firmly, «America.» It is impossible to adopt the suggestion of Prof. von der Hagan, that Waldseemüller was distinctly conscious of giving the new continent a name of Germanic origin. «Quia Americus invenit,» says the 'Introductio,' «Americi terra sive America nuncupare licet.» But the case stands otherwise when we ask why Europeans generally caught up the word. Its association with so many men before Vespucci certainly commended it to Northern taste.

MARRION WILCOX,
Author of 'History of War with Spain,' etc.

America, the second in size of the isolated land masses of the globe; containing about three tenths of the total land surface and perhaps half the cultivable area, but less than one tenth the population. The name was originally used only for central Brazil, and was fairly enough applied in honor of the Italian, Amerigo Vespucci (q.v.), who discovered it. It was first employed for the entire known Western world by Mercator in 1541, and is usually but not properly understood to include Greenland, which is physically a part of Europe.

The extreme points marking the limits of this vast continent are: N., the point of Boothia Felix, in the Strait of Bellot, lat. 71° 55′ N., lon. 94° 34′ W.; (in Alaska, Point Barrow, lat. 71° 23′ 31″ N., lon. 156° 21′ 40″ W.) S., Cape Froward, lat. 53° 53′ 45″ S., lon. 71° 18′ 30″ W., or, if the archipelago of Tierra del Fuego is included, Cape Horn, lat. 55° 59′ S., lon. 67° 16′ W.; W., Cape Prince of Wales, lat. 65° 33′ N., lon. 167° 59′ W.; and E., the Point de Guia, lat. 7° 26′ S., lon. 34° 47′ W. Its total area is not far from 16,000,000 sq. m., without Greenland or the polar archipelago (which comprise perhaps 1,000,000 more), of which North America with Central America and the West Indies contains some 8,700,000 and South America 7,300,000. There can be no pretense of exactness about these figures, however: Alaska and polar Canada are not thoroughly surveyed, and good recent authorities differ by 250,000 miles or more even as to accessible lands like South America. The total population is over 150,000,000.

Nominally one «continent,» it is really two if not three sections, geologically independent in origin. The northern, from the Arctic Ocean to the Isthmus of Tehuantepec in Mexico on the west (where the last slopes of the Anahuac plateau of the Rocky Mountains sink to the plain, and the Guatemalan highlands are not in sight) and Florida on the east, is connected with the southern by two great parallel ridges. One of these, called Central America, is continuous, joining South America at the west side, and dwindling to 28 miles across at the Isthmus of Panama; the other submerged, consisting of Haiti, Porto Rico, and the Lesser Antilles, joining at the eastern side; the two united transversely by Cuba and Jamaica and the projection of Yucatan, and enclosing the Caribbean Sea, 1,500 miles from end to end. The continental mass, 8,700 miles from Alaska on the northwest and Boothia Felix on the northeast to the south end of Patagonia, is prolonged by a vast archipelago of arctic islands up from Hudson Bay, ending suddenly like a drift line about 125° W. lon., and at Grant Land about 83° N. lat., and by another at the south called Tierra del Fuego, on the Antarctic Ocean, to a total of some 9,600, nearly four fifths the distance from pole to pole. But as with the eastern continent, some force has massed the land chiefly at the north: two thirds of the continent is north of the equator; the extreme point of the continuous northern islands reaches to a few hundred miles from the pole, the last of the southern is 2,350 miles from it; Alaska is 1,100 from the north pole, Argentina is 3,400 from the south. The same causes make it form part of a nearly solid ring on the Arctic Ocean, the northwest projection of Alaska being separated from the northeast of Kamchatka by only 40 miles of strait, and the continent being connected with Europe by a series of islands one to two hundred miles apart, while the immense though widely unequal gulfs of the Pacific west and the Atlantic east separate the habitable portions.

The axial dimensions of the continent are not very dissimilar to those of the eastern. Its length is about the same as the breadth of the other from China to England, its greatest breadth about the depth of the other from the Arctic to the Indian Ocean; but its relative slenderness gives it less than half the area. It is in fact an immense peninsula slightly severed from the main mass, with the shape and the southerly direction of the majority of peninsulas. From nine to ten thousand miles long, it is little over 3,000 across its main north and south lines, from Labrador to British Columbia, or from Peru to Brazil; about 2,100 from Savannah to San Diego, a few hundred across Mexico, 1,725 at the Tropic of Capricorn just above Rio Janeiro, 750 from Buenos Ayres to Valparaiso, and so on southward. Moreover, as shown by its configuration relatively to that of the opposite shores of the eastern, and the differences of the northern and southern continents, it is a strip rent from the eastern mass by a tremendous geological convulsion, the Atlantic being the channel thus left. That ocean is relatively small and of regular breadth from Labrador and Brazil to England and Liberia, compared with the immense abyss of the Pacific and its sweeping arch from the Bering Sea to Australia and Chile; from Newfoundland to

Ireland is but 1,900 miles, from Cape St. Roque in Brazil to Cape Palmas in Liberia but 1,700; while from San Francisco to Yokohama is 5,500, from Quito to Singapore (almost exact antipodes) 12,500, and from Valparaiso to Sydney 8,000. But a still more striking proof is that the continents fit together almost as accurately as the blocks of a dissected map, allowance being made for the long period since their separation. The great eastern projection of North America is toward the Bay of Biscay, that of South America toward the Gulf of Guinea, the great western projection of Africa toward the Gulf of Mexico and the Caribbean Sea. The same closure (about 45°) which would bring Newfoundland against Brittany, and Labrador against the British Isles, would make the Congo empty against the Brazilian coast and the West Indies surround Senegambia. In physical character also the northern and southern portions of each are akin: northeastern North America has the broken island-fringed peninsular coasts and the gigantic inlets and inland seas of Europe, while South America has the solid coast-wall and the absence of lakes characteristic of western Africa. Not to mention the great polar archipelago or Hudson's Bay, and allowing the archipelago at the south end of Chili to set off against the Alexander Archipelago along the south Alaskan coast, there is no parallel in South America to oceanic bodies like the Gulf of Mexico, or lesser ones like the Gulf of St. Lawrence northeast to Puget Sound northwest, or the Gulf of California southwest; or the mass of sheltered bays and sounds along the eastern coast to the Great Lakes; to islands like those around the mouth of the St. Lawrence or to Vancouver's, or peninsulas like Nova Scotia, Florida, and Lower California. It must be said, however, that the rent between the eastern and western continental bodies must have taken place very early, for there are strong physical differences between South America and Africa: the chief mountain ranges of the former being on the west, of the latter on the east; the African rivers are less copious, and mostly have cataracts above their mouths.

Apart from this, the structural characteristics of the northern and southern continents have striking similarities, largely nullified for human use by the difference in location already mentioned. Each is a rather slender triangle with the vertex to the south. Each is joined to the next northern portion of the globe by a northwestern peninsula, the trend of the whole as far south as Bolivia being regularly southeast from Bering Strait, just as that of the Asiatic coast to the Philippines is southwest; so that the north Pacific is a semicircular gulf. Each has to the north an immense archipelago and a vast island-ringed inland sea. Each has a framework of mountain and plain correspondent in general, though with some important differences. In each, according to the law that the largest continental mountain chain is on the side of the largest ocean, there is a western range of immense height and mass, hundreds of miles broad and split into parallel sections sometimes connected by transverse spurs, stretching its entire length; quite recent in origin, and the volcanic action which raised it still energetic in parts. The Andes in South America thus correspond to the Rockies in North America; but the current idea that they form part of one continuous system is erroneous,— the Andes end in Venezuela, and the Rockies are of different genesis. Each continent has on the east a much shorter chain, much older and therefore much lower, from the erosion through geologic ages, and its volcanic fires long since spent; and as the highest points are worn down earliest, each is now rather a broad plateau with some elevations than a mountain wall. The Alleghany-Appalachian system in the United States corresponds to the Brazilian chain, which has no one distinctive title. Each continent has also a lateral range beginning in the north centre, turning first south and then east till it ends somewhat north of the eastern vertical chain, and cut in its course by the chief river running northeastward; and in each it is much the oldest part of the continent. The Laurentian chain in North America, crossed by the Saskatchewan, is a trivial counterpart to the great lateral ranges of Venezuela and the Guianas, crossed by the mightier Orinoco.

In each continent the two main ranges are connected by an almost uninterrupted plain many hundreds of miles broad, sloping southward to the ocean, and drained by three immense hydrographic systems with slight and sometimes non-existent divides: one running east and emptying just north of the eastern vertical range, the Great Lakes and the St. Lawrence in the north corresponding in position to the oceanic Amazon in the south; the second running south and discharging a little south of the same range, which thus forms one side of a huge triangle of which the rivers form the other two,— the Mississippi and Missouri in North America comparable to the Parana and Paraguay which form the La Plata in South America; a third running northeast and discharging into the northern ocean, the Saskatchewan, with the Red River of the North and Lakes Winnepeg and Manitoba, corresponding to the Orinoco. Besides these, each has a river following the eastern side of a spur from the main range up to the northern ocean, the Mackenzie in the arctic regions and the Magdalena in Colombia, though the former is the drainage of a great arctic plain while the latter is confined between two ridges. With regard to the watersheds, those of North America lie within a few miles of each other in Minnesota; the headwaters of the Illinois in the Mississippi basin lie within a half mile of the Chicago in the St. Lawrence system, and the two have now been connected; the Amazon and Plata systems are only three miles apart; and those of the Amazon and Orinoco are actually connected by the so-called "river" Cassiquiare, a deep and broad natural channel about 150 miles long, running either way according to circumstances.

These, however, by no means exhaust the large drainage systems of North America, though in South America the closeness of the western chain to the ocean throws the whole burden on the east. The Pacific slope of the north is drained in the semi-arctic regions by the immense Yukon, one of the great rivers of the globe. On the eastern side the great mass of the arctic moors sends its drainage through a network of small streams, and sinks like Great Bear, Great Slave, and Athabasca


NORTH AMERICA
SCALE OF MILES.
Population of places is indicated
by different lettering, thus,
500,000 and over .... NEW YORK
100,000 to 500,000 .... Buffalo
50,000 to 100,000 .... Charleston
10,000 to 50,000 .... Petersburg
Smaller towns .... Chattanooga
Railroads
ASIA
ARCTIC OCEAN
BERING SEA
ALASKA
PACIFIC OCEAN
DOMINION OF CANADA
HUDSON BAY
BAFFIN BAY
GREENLAND
ICELAND
NEWFOUNDLAND
UNITED STATES
ATLANTIC OCEAN
TROPIC OF CANCER
SAN FRANCISCO
Los Angeles
St. Paul
Minneapolis
Milwaukee
CHICAGO
Detroit
Toledo
Cleveland
Buffalo
Toronto
Montreal
Quebec
BOSTON
NEW YORK
PHILADELPHIA
BALTIMORE
WASHINGTON
Pittsburg
Indianapolis
Cincinnati
Louisville
St. Louis
Kansas City
Omaha
Denver
Memphis
Charleston
Savannah
Bahama Islands
GULF OF MEXICO
Havana
Jamaica
CARIBBEAN SEA
CENTRAL AMERICA
SOUTH AMERICA
Longitude West from Greenwich

Lakes, by the Mackenzie to the northern ocean, the Great Fish River taking the east arctic waters. Farther south the Pacific drainage is by the Fraser into Puget Sound, and by the Columbia into the Pacific. The smaller Sacramento drains central California. The Great Basin between two arms of the Rockies sends its scanty and precarious rainfall into the Gulf of California by the Colorado. East of the range in the south the Rio Grande has a long course and forms the boundary between the United States and Mexico, but, despite its impressive name, is not of great volume. Between this and the Mississippi system several considerable streams drain the Texas region; the Colorado, Brazos, Sabine, etc. East of the Appalachian system a number of fair-sized and beautiful rivers flow to the Atlantic — the St. John's, Penobscot, and Kennebec, the Connecticut, Hudson, Delaware, and Susquehanna, the Potomac, James, Cape Fear, Savannah, etc. In South America the large rivers of the eastern slope are the San Francisco and the Paranahiba of northern Brazil; but between this range and the Amazon system a great plain is drained by the huge Tocantins, which, though emptying only at the mouth of the Amazon, is really a part of its basin.

The drainage systems of America have no parallel on the globe. The Amazon discharges more water into the sea than the eight largest rivers of Asia together, and the Mississippi more than all the streams of Europe large and small. The navigable waters of the St. Lawrence, Mississippi, Amazon, Orinoco, and Plata systems together amount to over 100,000 miles in length. The five Great Lakes of America alone, excluding large bodies like Winnipeg, Manitoba, Champlain, etc., and the polar lakes, make up an area of 89,000 square miles, or considerably more than England and Scotland together.

Another physical similarity between the two continents might be found in the relations of the Gulf of Mexico to the northern continent and the great Argentine plain to the southern: both lie in the same position with regard to the eastern and western mountain chains, though the one is submerged.

But the differences are also great. The main drainage system of the central plain in North America is to the south, by the Mississippi; that in South America is to the east, by the Amazon; while the Great Lakes are scarcely a drainage system at all for anything but the melting snows of the Rockies, which supply them through deep rock fissures. They are hollows in the oldest rock elevation of the continent, with the ground sloping away from them in every direction not far from their shores; not a single considerable stream flows into them, nor even into the St. Lawrence west of Montreal. But the most vital difference structurally is due to the position of the western chain. In North America the chief height is on the eastern flank a thousand miles from the Pacific, the gradually lessening slopes leaving space for an empire along that ocean, and their drainage forming great rivers. In the southern continent it hugs the ocean so closely that not a stream of any size flows into the sea, and the cultivable area is but a petty strip on the coast. More than half the whole western side of South America is occupied by one state, some 1,500 miles long by 50 or 60 wide, which even so finds none too much territory with its slender width and partly barren soil. The northern continent has also an immense advantage in the character of its coast line: what with its archipelagoes, sounds, and river-mouths in the north, and the sheltered indentations farther south, it is well fitted for commerce, while the whole South American coast has only one or two good harbors above Patagonia. The greatest differences in the civilized destiny of the two continents, however, are due to the northward massing of the land heretofore mentioned. All the United States and southern Canada lie in the temperate regions: the largest and most fertile part of South America lies in the tropics. The narrow southern part of North America lies in the warm semi-tropic ocean; that of South America in the south-polar sea. A quarter of all North America is a worthless polar waste, but perhaps as large a space of South America is an uninhabited and pestilential tropic jungle; and the improvements in food production and means of warmth which push back the reign of the one are perhaps balanced by the hygienic inventions and commercial uses tending to reclaim the other. Certainly the northern part has much more arable land and much less miasmatic or enervating climate than the other, nothing whatever that compares with the pestilential coasts and inland swamps of the southern. The Mississippi valley, the largest continuous body of agricultural land on the earth, is not only of immensely greater value than the grassy steppes of the temperate southern plain of South America, but the prairies of the north, which correspond in position to the Amazonian forests in the south, are a still more striking contrast. Commercially the north is equally favored in comparison. From the nearness of the continent to Europe relatively to Asia, and from the structure of the continent throwing the mass of population and production east of the great mountain chain, the chief commercial relations of America must always be with the western side of the other continent. But North America is directly opposite Europe, the commercial head of the world; while South America's eastern neighbor is barbaric Africa, and most of its harbors are either along the miasmatic northern and northeastern coast, unfit for great cities, or the semi-polar shores of Patagonia.

(For general works on American geography and topography see the 'New Universal Geography,' translated by Keane and Ravenstein from Elisée Réclus' French work, 1890–4; Dawson's 'North America, Canada, and Newfoundland,' 1897; Keane's 'Central and South America,' 1901; Shaler's 'Nature and Man in America,' 1891; Wright's 'Ice Age in North America,' 1889; Powell's 'Physiographic Regions of the United States,' in 'National Geographic Monographs,' Vol. I. 1895.)

Physical and Climatic Conditions.— In a continent practically spanning the entire space from pole to pole, every variety of climate may be inferred; and with every elevation from sea-line to everlasting ice even in the tropics, each latitude is sure to contain as endless varieties in itself. In both North America and Asia the western side is both warmer and of more even temperature than the eastern, owing to ocean

currents generated in the tropics and flowing eastward, the Gulf Stream through the Atlantic, the Kuro Shiwo through the Pacific. The Rockies, however, give a peculiar character to western North America, to be mentioned later, and even in interior Alaska the isotherms rise, — the parallel of Dawson City in the Klondike is that of the north end of Hudson Bay and far into south Greenland. The eastern side of both continents has about the same climatic belts: China corresponds fairly to the United States, and Peking has a climate not unlike Boston. But if we compare eastern North America with Europe, and to a less extent South America with the East, the leading trait is its greater cold in every zone from just below Great Bear Lake; St. Petersburg and Christiania are on a level with the southern tip of Greenland. Sitka has much the same parallel as Aberdeen; Copenhagen and Moscow, Glasgow and Edinburgh, correspond with central Labrador, northern James Bay, and some distance north of Lake Winnipeg. All the British Isles, all the Netherlands, and the greater part of Germany, are north of the city of Winnipeg, which itself is about on the parallel of Paris; St. Paul and Ottawa correspond to Bordeaux, Turin, and Bucharest, centres of wine and roses; Boston and Chicago to Rome, New York to Naples; Philadelphia is south of Madrid and Constantinople; Washington corresponds to Lisbon and Corfu, St. Louis to Athens. The thirtieth parallel is about that of New Orleans and the Isthmus of Suez; the twentieth passes through the heart of Mexico, also just below Calcutta and Mecca, and through the Sudan and Sahara; the tenth through Venezuela, also through Guinea and just above Ceylon. The equator touches Quito and the mouth of the Amazon, and also divides Sumatra and Borneo and Lake Victoria Nyanza; the Amazon and the Kongo traversing about the same zones. Even allowing for the elevation of the Mexican plateau, the temperatures of India and of the deserts of Arabia and Africa cannot be paralleled even on our tropical coasts. The difference is due to environing conditions and internal structure combined. Above the European mass is a partially thawed sea; above that limit in America lie many hundred miles of ice-clad land masses, while to the northeast is the continental mass of ice-capped Greenland, piercing deep into the eastern side the polar inlet of Hudson Bay. But a partial cause is the mountain framework which in Europe lies mainly east and west and in America north and south. In the latter, therefore, what is practically one long plain stretches from the Arctic Ocean to the Gulf of Mexico, the polar winds finding no obstruction as they sweep southward. There is not a spot in North America east of the Rockies absolutely secure from intense frosts; and there are no definite north-and-south climatic belts, the only sharp divisions being those east and west of the Rockies. In Europe and west Asia, on the contrary, where the mountains cut off the polar winds, the climate will often vary from north-temperate to semi-tropic within a score of miles. This isolation of different parts, giving the most varied lives and habits time to grow into deep-set racial distinctions, has produced by their varied strains and interaction the splendid civilization of the Western world; while the two great plains which fill the centre of each continent, linked by a fertile and temperate plateau, in itself the most tempting of all, gave no opportunity for differentiation, and the undiversified monotony of a single racial stock and culture was one of the influences which kept progress at a spot reached by European races thousands of years before.

Geology.— The great western chain of both continents, which would seem to be the chief formative base of both, is in fact very much the newest section in each case, though each is of independent origin as shown by the energy of still remaining volcanic action in both, while the uplift of the eastern side has so long ceased that erosion has worn them down many thousands of feet, trenching immense valleys, and building up vast plains to the west by their detritus.

The Archæan portion of North America, the first in order of appearance above the water, is the northeastern part: the elevation in which the Great Lakes and Hudson Bay are hollows, the Laurentian system of Canada, the Adirondacks of northern New York, and a southern tongue east of the Blue Ridge. The line of forces thenceforth acted steadily to the westward, the surface formations regularly growing more recent in that direction. This portion is not merely the oldest of the western continent, but one of the oldest on the globe, the "New World" being new only from the standpoint of European history, not of geology or ethnology. This and the polar archipelagos are composed of Azoic or Palæozoic rocks of extreme antiquity. The mountain escarpment skirting Labrador and extending north and west is mainly granite and other archaic rocks. To the west stretches the vast pre-Silurian plateau called by Suess the "Canadian buckler." By erosion this has been almost denuded of its upper Palæozoic strata, and the whole of Hudson Bay excavated to a slight depth on the surface of its eastern section. The eastern part of the Appalachian system is mostly Silurian; its western plateau and the bases of most of the Mississippi valley are Carboniferous; while as we go westward we encounter in succession Triassic, Cretaceous, and Tertiary formations.

The Rocky Mountain system shows the greatest activity of volcanic forces at its ends, in Alaska and Mexico. In the old portions of the United States and Canada there are no active volcanoes; and the strength of eruptive force, greatest in the Aleutian Islands, steadily diminishes eastward and southward, occasional eruptions occurring on the southwestern coast, while Mount Wrangell is semi-eruptive only. In Mexico, Popocatapetl and others indicate the beginning of the equatorial belt of volcanic forces exhibited in Central America and the Antilles. But all the Cordilleran system is relatively of recent elevation, though old enough for heavy erosions to have taken place, exposing strata of every age as they were tilted up, creating some valleys and filling up others. In the region from California to Puget Sound the surface over many thousand square miles is lava, the valley of the Snake and Columbia for long distances being cut through lava beds, and fields of black scoriæ forming a peculiar feature in the northern Pacific States and Pacific Canada. To the south of the Appalachian system, along


NORTH AMERICA
(Political)
SCALE
0 100 300 500 700
700 Statute Miles to one inch
Capitals of Countries Capitals of States
Other Cities
Comparative Area
KANSAS
82,080 sq. m.
DOMINION OF CANADA
UNITED STATES
MEXICO
CENTRAL AMERICA
SOUTH AMERICA
GREENLAND
HUDSON BAY
GULF OF MEXICO
CARIBBEAN SEA
WEST INDIES
CUBA
HAVANA
TROPIC OF CANCER
EQUATOR
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
Winnipeg
OTTAWA
Quebec
Halifax
Boston
New York
Philadelphia
Baltimore
WASHINGTON
Chesapeake Bay
C. HATTERAS
Chicago
St. Louis
St. Paul
Duluth
Detroit
Denver
New Orleans
Salt Lake City
San Francisco
Los Angeles
Portland
Sitka
Mt. Whitney
Mt. Rainier
Mt. St. Elias
KODIAK I.
VANCOUVER I.
QUEEN CHARLOTTE IS.
C. FLATTERY
KLONDIKE REGION
ALASKA
ALEUTIAN IS.
BERING SEA
PARRY ISLANDS
BAFFIN BAY
NEWFOUNDLAND
St. Johns
GREAT NEWFOUNDLAND BANK
C. SABLE
GREAT LAKES
ROCKY MOUNTAINS
SIERRA NEVADA
San Juan
HAITI I.
BRITISH HONDURAS
Mexico
13000 ft.
0500 ft.
120°
Longitude West from Greenwich
Latitude North


ARCTIC OCEAN
Bering Strait
BERING SEA
BAFFIN BAY
Davis Strait
HUDSON BAY
PACIFIC OCEAN
ATLANTIC OCEAN
Gulf of California
GULF OF MEXICO
CARIBBEAN SEA
NORTH AMERICA
(Relief)
SCALE
0 100 300 500 700
760 Statute Miles to one inch
Dark Brown indicates highest land
Dark Blue indicates deepest water

the Atlantic and the Gulf, the flooring is Cretaceous and Tertiary, therefore of recent uplift.

In South America the eastern highlands are also of enormous antiquity, as shown by their archaic composition, with a sandstone cap not since submerged, their horizontal layers, deep erosions, and detritus plains, indicating no uplift since the earliest times and a great height of the original chain. The Andes (q.v.) are quite recent, and full of volcanoes still or but recently active, but they are not all of a single age, however, and show successive uplifts. The plains between have Tertiary bases under their alluvial surface.

Much of the erosive action on these primitive elevations and the uplifts between them has been due to a vast glacial ice cap, the so-called Laurentian glacier, which at an uncertain but relatively recent period, ending probably from 50,000 to 100,000 years ago, covered all North America from the polar regions down to Philadelphia and the Ohio and as far west as the Missouri, leveling hills and hollows, creating soils, excavating lake beds, changing the courses of streams and the outlets of gigantic lakes, cutting out and blocking up fiords and harbors, and depositing enormous masses of rock and gravel moraines. To this, among other things, is due the creation of New York harbor and Niagara Falls, and the turning of the Great Lakes through the rocky St. Lawrence valley instead of the Mohawk and Hudson. This ice cap has by no means wholly disappeared yet: the immense glaciers on the northwest coast and in the Rocky Mountain heights, some of them hundreds of square miles in extent, are remnants of the one great glacier of ancient times which still covers entirely the turtle-back conformation of Greenland. South America too has had its glacial periods, spreading from the south-polar regions and producing the same effects as in its northern neighbor. The great height of the Andes keeps them still existent up to and beyond the equator, and on the south they are of frequent occurrence.

The Cordilleran System.— The two great axial chains which form the western base of the double continent, though (as said) of independent origin, have strong similarities and a like relation to the remainder of the surface, and may conveniently be treated together. For their detailed composition and characteristics, see ANDES and ROCKY MOUNTAINS. It should be noted that these are not mere dividing walls, but vast formative elements of the continental masses, and themselves of continental volume. With their foothills and spurs they amount in South America to at least 1,000,000 square miles in area, and in North America to some 2,500,000, or toward a third of the entire surface. They include almost every possible character of soil and climate and natural product, and suitability for every employment,— agriculture, manufactures, or mining. They make climates of their own, so that no inference can be drawn from that on one side to that on the other, and the two may have the difference of five degrees of latitude or five thousand miles of distance: one side may be a sponge, the other a rainless desert, one a glacier, the other a garden. They make the difference between Puget Sound and Labrador, and on the other hand between the Mexican plateau and the Nicaraguan plains, between Peru and Carácas. They enclose fertile provinces and deserts of rock and sand each large enough for an empire, and have great lakes and considerable rivers entirely their own.

As the development is better studied from the south, we shall begin with South America, whose cordilleras descend by steep short terraces to the seashore, or to a narrow belt of level land immediately adjoining it, form regular chains, display the loftiest masses of all America, and send out only short branches to the eastern plains; whereas the North American cordilleras lean, in the west, on elevated plateaus, so as to favor a large development of rivers, are less vertical in their structure and less high, and send to the east more extensive ramifications. The names of particular groups of the Andes are taken from the countries to which they more especially appertain; thus, proceeding from south to north, we have the cordilleras of Chile, Bolivia, Peru, Ecuador, and Colombia. This is the highest mountain mass on the globe, and except the Himalayas has the highest peaks. Beginning among the rock islands of the Fuegian archipelago, it runs through Patagonia as a low single range with summits of perhaps 8,000 feet; rises swiftly through Chili, growing at once higher and more multiplied, with summits of 12,000 to 18,000 feet, till it culminates in the stupendous *nevado* of Aconcagua, from 23,000 to 24,000 feet high, the loftiest elevation on the western hemisphere. Beyond this it divides into two enormous parallel arms with a high plateau between, and lower ranges to the east in Argentina increasing its complexity. Thence to the Isthmus it is not a ridge, but a rock continent 200 or 300 miles wide, with a great number of peaks from 19,000 to 21,000 and even 22,000 feet high, and the very «passes» over them 15,000 or 16,000 feet above the sea, terrific and nearly impassable gorges above the highest summits in Europe. Sometimes it contains three or four parallel ranges, with two and even three immense tillable valleys on the same base. It attains its greatest breadth at about lat. 18° S., in central Bolivia, where it is some 300 miles wide, with three main ranges; and at this point, in the northern part of the province of Tacna, taken by Peru from Bolivia, it and the correspondent coast curve northwest as far as 5°, its course in this direction being exactly coincident with the limits of Peru. On these plateaus was situated the empire of the Incas. Just northeast of the turn it holds the great Lake Titicaca, some 1,800 miles in area, on a high plateau 12,645 feet above the sea. This part is called the Royal Cordillera, and contains several peaks above 20,000 feet, Ancohuma (21,490) being the highest. At the Gulf of Guayaquil it again turns north, with a gradual trend east to about lat. 4 N., when it curves north and west to meet the Isthmus, forming a large but nameless gulf. Near the equator, in Ecuador, are a number of very lofty volcanic summits, the two highest and most famous of which are Chimborazo, 20,498 feet, and Cotopaxi, 19,613 feet. Thence to the Caribbean the height decreases, and in Colombia it divides into three, two running north and the third extending well into Venezuela, the true end of the Andean system.

Central America is hardly a part of either great system. The Isthmus is a low plateau, succeeded by highlands rather than mountains in Costa Rica; then comes the depression nearly filled by Lake Nicaragua, the largest inland body of water south of the Great Lakes, where the elevation sinks to less than 100 feet above the sea. The mountains begin in northern Nicaragua and occupy the entire breadth of Honduras, Guatemala, and Salvador, from ocean to ocean, but they are not of great height and consist of several detached ranges with active or extinct volcanic peaks. These sink to the broad plain at the Isthmus of Tehuantepec, forming the dividing line between the mass of North American and South American organic species, though zoölogically the central plateau is a northern tongue thrust into two lines of tropic territory along the Gulf and Pacific coast.

The Rocky Mountain system, or northern Cordillera, begins with the plateau of Anahuac on which the City of Mexico is situated, the seat of the original culture overthrown by Cortes. It is from 4,000 to 7,000 feet high, and is flanked by mountain ranges and isolated volcanic peaks, active or quiescent, the highest summits in Mexico. Orizaba, the loftiest, is 18,250 feet high, but the most remarkable and imposing is Popocatapetl, rising 17,520 feet from the floor of the valley, the highest peak of the world in practical isolation, its whole height visible from sea level. At this point the main ridge of the Rockies (the Mexican section is known also as the Sierra Madre, which properly is the name of the northeastern spur) suddenly turns far eastward from the Pacific, and for the remaining 3,500 miles of its course keeps hundreds of miles from it, so that the broad western slope is drained by very large rivers, as the Columbia and Fraser, and in the extreme north the mighty Yukon, one of the great streams of the whole globe. But it throws out lesser arms to the west nearly to the ocean. Between the main range and the great Sierra Nevada arm is enclosed the desert Great Basin of Utah and Nevada and northern Arizona and New Mexico: a waste of alkaline earth and naked rocks, of river courses dry except in the infrequent rains, and roaring torrents then for a few hours or minutes; of the great cañons, gulleys cut sometimes a mile deep into the solid rock by the swift sand-laden currents. It is drained to the Gulf of California by the only real stream of water of any size in the whole region, the Colorado. The Sierra Nevada has for its crowning summit Mount Whitney, in California, 14,898 feet high. Still farther west it throws out the Coast Range, running through California, Oregon, and Washington up to Puget Sound. The Sierra Nevada is continued, through independent volcanic action, by the Cascade Range of Oregon, Washington, and British Columbia, with Mount Shasta, 14,510 feet, in the south, and Mount Rainier or Tacoma, 14,526 feet, in Washington. The system as a whole, across from California and Oregon to Colorado and Wyoming, is 1,000 miles wide, with a number of north-and-south ranges rising from a plateau from 5,000 to 10,000 feet high, and with a large number of peaks between 14,000 and 15,000 feet high. The main range in Colorado has for its chief divisions the Front, Sangre de Cristo, Park, Sawatch, and San Juan ranges; Long's and Pike's Peaks, Blanca Peak, Mounts Lincoln and Harvard, and Uncompahgre Peak are the best known of the summits.

The system follows the coast around nearly to Asia, rising in peaks all along the Aleutian Island, the chief being the noble Shishaldin, 8,000 feet high; and north of Yakutat Bay, a great landmark, where the coast turns west and the greatest glaciers begin, the place where the temperate zone properly gives place to the semi-arctic. A branch continues straight on, runs far north to the Yukon watershed, then turns west again and rejoins the other in southwest Alaska. In the course of the latter it throws up mighty peaks, the monarchs of the northern continent, including Mount St. Elias, 18,024 feet, and Mount Wrangell, a great isolated semi-active volcano, 17,524 feet; the altitude rising as it goes west, it culminates in Mount McKinley, 20,464 feet, the highest elevation in North America.

The Eastern Mountains and the Plains.— In North America the backbone and nucleus of the continent is locally known as the Alleghany system in the northern half of the United States, and the Appalachian in the southern; but for scientific purposes the latter name is commonly extended to the whole. It extends from Gaspé peninsula, between the lower St. Lawrence and Chaleur Bay, below Quebec, through the United States to north Alabama and north Georgia, where the mountains sink down to the great coastal plain which girdles the United States from fifty to a hundred miles back from the coast shore. Between the mountain and plain is a foothill region usually known as the Piedmont region. The mountains are a plateau from 50 to 200 miles wide and averaging 1,500 to 3,000 feet high, but with peaks rising to 6,294 feet in Mount Washington (New Hampshire) and 6,707 feet in Mount Mitchell (North Carolina). The range has many local names for the different divisions, as the White and Green, the Adirondacks, the Taconic, Hoosac, and Catskill, the Alleghany, the Blue Ridge and South Mountain, the Black and Smoky, etc.

On the west they slope through rolling uplands to the most peculiar feature of the North American surface, entirely unlike any other part of the globe, the prairies, called savannahs in English books, but never in American speech: a block of undulating plains of enormous extent in the centre of the Mississippi basin, composed mainly of dark, rich loam from a foot to several feet deep over a bottom of clay, and of such composition that tree-growth is entirely absent naturally and very difficult artificially, even where rainfall is plentiful, though grass and other crops grow abundantly. Often this will be as level as a floor for scores of miles together, and the eye sweeps uninterruptedly over a grassy ocean to the horizon. On the west of this extend to the Rockies lands often as flat as the prairies, but lacking their individual trait and called plains instead. The same features are repeated in northwest Canada from Manitoba to the Rockies.

In South America the eastern chain is similarly formed of several parallel ranges following the Brazilian coast, on a wide plateau, a reduced copy of it running through the Guianas.

The whole centre is an immense plain sloping sharply up to the Andes; but in place of the vast treeless flats of the northern continent there is the most enormous forest of the world, two and a half millions of miles in extent, a swampy jungle inhabited only by a unique tropic fauna and the few savages who wander through its intricate paths. North of this, however, are considerable plains along the Orinoco called llanos. Below the range the country is a great grassy steppe, rather ill-watered and infertile, called pampas, and extending through Argentina and Patagonia.

(See reports, bulletins, and monographs of the United States Geological Survey; reports of the Canada Geological and Natural History Survey; Suess' 'Das Antlitz der Erde' (The Face of the Earth), Prague 1883-8; Felix and Lank, 'Geologie und Paläontologie der Republik Mexico,' Leipsic 1890; Steinmann, 'Sketch of Geology of South America,' in 'American Naturalist,' Vol. XXV., 1891.)

Climate, Rainfall, and Natural Sections.— The habitability of a land outside of arctic regions depends first upon its water supply and secondly upon its disposition. The trade winds which supply the rainfall of all countries by the ocean vapors they carry blow nearly east and west, the easterly called specifically «trades,» the westerly «anti-trades.» The eastern continent has its greatest length in this direction and a great mountain wall on the east; hence much of central Asia lying beyond the reach of vapors remains a permanent desert. America, from its narrowness and its sides being toward these winds, is much more easily supplied. The Great Lakes add to the rainfall in their region; the Gulf of Mexico, as will be demonstrated, turns the whole east centre from a potential desert to a garden: and the only entire deserts are between two arms of the western range in the northern part, and some portion of the strip along the western coast of the southern.

In the polar regions the cold and physical conformation make the water supply of little avail. Northern Alaska and northern Canada are flat, spongy moors but half reclaimed from the ocean, with permanently frozen subsoil, thawing slightly in the brief, intense summer (sometimes of 120°), and developing a few mosses, grasses, and weeds, with dwarfed shrubs and clouds of mosquitoes. (See ALASKA.) But the distance southward to which arctic conditions extend is far greater on the eastern coast than the western, owing to the effect of the Rocky Mountain wall in breaking the force of the polar winds, and of the warm ocean vapors; the latter also make the temperature far more equable. The midwinter arctic temperature of 50° and below has no representative on the western coast. The Labrador coast, latitude for latitude, is 20° colder than the Alaskan in mean annual temperature, about 20° against 40° even in the extreme northwest; and its mean midwinter temperature 30° colder, —25° against 5°. Even from the interior to the western coast the isotherms rise astonishingly: that of north Virginia at lat. 40° N. is that of British Columbia at 50°. On the other hand, the range of temperatures is much greater on the east, the temperature rising pretty steadily as we go southward, to 80° mean annual on the Mexican Gulf coast, a range of 60° from semi-arctic to semi-tropic, while in the corresponding part of southern California it is only 70°, a range of 30°. The midwinter range is over 100° on the east coast, not above 50° on the west; the midsummer is 40° in the east, not over 20° on the whole coast from southern California to Bering Sea. Much greater extremes still are found in the Cordilleran region, where the mean annual embraces a scale of 60°, and the mean midsummer runs from 40° to 95° in southern Arizona and northern Mexico, while the thermometer rises to 120° at times, as at Fort Yuma and similar places.

From about lat. 52° N. to perhaps 44° in the interior and east, the climate, though not quite fatal to civilized energies, is very severe, with winters of seven or eight months, and summers at best but short and not always calculable, though rising to 100° and over in waves; with sudden intense «northers» and «blizzards» of intense cold with fine dry snow sometimes paralyzing business activities for days. The dry atmosphere, however, makes it less trying than the damper though somewhat warmer eastern weather; it has developed great cities and populous States in the United States and flourishing communities in Canada above 50°; and the industrial and intellectual future of the region is as promising as that of any part of the continent. There is not much difference between the central and eastern parts in this respect, Duluth and Quebec, St. Paul, and Ottawa, corresponding closely in parallels and nearly in climate. Northwestern Canada and the northern central States of the United States form the great cattle and wheat district of North America; and this on both sides of the Rockies is the chief timber section. South of this is the great «temperate» section, shading into the semi-tropic by imperceptible degrees, but which in the United States may be roughly divided by the basin of the Ohio. The northern portion has summers and winters of the same general character as the former, but less intense at either extreme, neither hot waves nor cold waves usually lasting long; the weather damper than in the farther north. It is the chief region of Indian corn and apples, hay and potatoes, etc. The southern half shows the beginnings of tropic elements in the seasons, which are not so much winter and summer as wet and dry; in the luxuriance of vegetation and characteristically tropic varieties: in the less bracing atmosphere, and in the bottom lands its languorous oppressiveness; in the domestic architecture, where the obvious desire is to escape heat rather than to ward off cold; and in the productions, such as cotton and tobacco, rice and sugar, sweet potatoes and oranges in the far south.

The Pacific slope, however, is an exception to this, its climate resembling the western coast of Europe much more than the eastern of its own. All the isothermal lines curve sharply northward west of the mountains. From Puget Sound to San Diego there is no extreme range of climate, no such division into quasi-arctic and quasi-tropic as on the eastern slope; though the northern part from its heavy rains is the greatest timber region of the continent north, and the southern a great country of vineyards, almond orchards and other south-temperate products. California reaches from about the

parallel of Boston to that of north Georgia and Mississippi, but has neither the raw, harsh New England climate nor the heavy southern atmosphere, and southern California is a noted warm sanatorium. The high arid plateau of north Mexico experiences extreme alternations of temperature, from 95° to 40°; but on the coasts and below the great Anahuac table-land the region becomes semi-tropic. Sugar-cane, cotton, and coffee now ascend to the lower mountain regions, and in their place, at sea-level, appear pineapples, bananas, etc. Central America from its narrowness and low elevation has an island climate, tropic and pestilential on the shores and along the streams, moderate and healthful on the higher ground in the interior. This and the Antilles are the region of sugar, indigo, cochineal, ginger, vanilla, capsicum, etc. South America, lying on both sides of the equator, has in the central and eastern parts a much less range of climate than North America, the greatest in a single section being found in Argentina, where it is some 30°; over the whole continent the mean annual temperature ranges from 80° to 40°, the midwinter (our midsummer) from 80° to 35°, and the midsummer from 85° to 50°; north Argentina, the Cordilleran section, having, as before, the greatest alternations. The southern west Andean slopes are cooled and equalized by the west winds from the ocean; the northern parts are a tropic desert; but on the different levels of the range are found every climate of the earth from tropic to arctic. The tropic productions and characteristics south of the equator, except as deflected by local conditions, are much like those north of it. The zone reaching south as far as lat. 40° S. has a mean temperature of 71° in the warmest and 53° in the coldest month. There the palm still thrives on the lower basin of the La Plata beside the mulberry and indigo; the pampas and the west coasts of Chile are characterized by beautiful araucarias (the pine of the southern hemisphere), by beeches and oaks, the potato and the arrowroot. The plants in cultivation are a curious blending of the vegetation of the northern and southern United States: wines, olives, oranges, hemp, flax, tobacco, wheat, Indian corn, and barley. The southern limit of the periodical rains reaches as far as lat. 48° S., when the mean temperature of 59° in the warmest and 39° in the coldest month still favors the growth of cereals, and on sheltered spots of the west coast the growth even of the vine and the finer fruits. The zone reaching to the southern extremity of America shows comparatively little difference between the warmest and coldest month, the mean temperature of the one being 41° and of the other 25°; but the low degree of summer warmth produces a marked change in the form of vegetation, which now presents only a few trees, as the beech and birch, and an extraordinary abundance of mosses and ferns. As in passing from the equator to the pole the region of the vegetable world gradually declines, so in climbing from the tropical shores to the ice-covered mountain summits three different climates have been distinguished by the names of *tierra caliente, templade* and *fria* (hot, temperate, frigid). Of these the *templada* extends over those healthy and beautiful regions where a kind of perpetual spring prevails, and green pastures and noble forest trees are found united with the fantastical and gigantic forms of the tropics.

The question of rainfall is difficult to group systematically with that of climate. The mass of the northern continent is in the region of the anti-trades or prevailing westerly winds. The Japanese Black Current, the Gulf Stream of the Pacific, running northeast and striking the polar currents and the cold shores, ice-bound for many hundreds of miles, sends up a great steam of fog which is blown against the wall of the Rockies and sent back by them upon their western slope in a rainfall from 50 inches up to 100 or even more, that makes the northern coast from southern Alaska to northern California one gigantic forest of immense timber. The rainfall on Puget Sound is from 75 to over 100 inches in winter, and the annual average on the Pacific coast of Alaska is 90 inches. In the southern part, along southern and Lower California, the Cordilleran region above the Gulf, and west Mexico, the same winds blow; but the land is too warm to cool and precipitate the vapors to the same extent; and such precipitation as there is takes place mostly on the crests of the coast ranges, the Cordilleran region being mostly semi-desert or wholly so. In the summer the coast ranges are too warm to retain all the moisture of the vapors, which therefore give a little at these seasons, 10 to 20 inches in all to the interior regions.

The Mississippi valley is saved from becoming the most tremendous desert on earth, a second Sahara, by the Gulf of Mexico and the western wall combined. If it had to rely on the Pacific winds it would be utterly rainless; but these westerly winds in the Gulf region set up whirls of cyclonic disturbance which make an easterly eddy, carrying saturated currents in that direction; and these, striking against the Rockies, are turned northeastward through the central and eastern valley, giving it abundant water. This eastward set, however, leaves the western valley only the edge of its course; the far western, as in western Kansas and Nebraska, being rainless for considerable periods and scantily supplied at best. The rainfall ranges from 60 inches on the coast to 30 around the Great Lakes, which add something to the moisture of their district. The same cyclonic movement makes the same easterly eddy in the Atlantic, and the Atlantic coast receives its 40 to 50 inches a year from that source.

Central America is in the region of the trades or easterly winds, and is so narrow that its climate is that of a semi-tropic island. In this region the rainfall is enormous, creating heavy tropic vegetation and increasing to 200 inches at Panama and the northwestern shores of South America, short rivers like the Atrato carrying almost a continental volume of water. All tropical South America is within the trade-wind belt, its moist warm climate creating the enormous forests of the Amazon basin, the oceanic volume of that «river» (rather a huge set of parallel drainage channels in one vast swamp) and its tributaries, and the lesser but still mighty Orinoco. On the western slope of the Andes this portion receives no vapor and is a desert down to north Chili. But in central and south Chile and Argentina the anti-trades begin once more, and North American conditions


SOUTH AMERICA
SCALE OF MILES ON EQUATOR
Population of places is indicated by different lettering, thus.
RIO DE JANEIRO
Bogota
Quito
CARIBBEAN SEA
CENTRAL AMERICA
PACIFIC OCEAN
ATLANTIC OCEAN
VENEZUELA
COLOMBIA
ECUADOR
PERU
BOLIVIA
BRAZIL
GUIANA
ARGENTINA
URUGUAY
Brazilian Guiana
Matto Grosso
Amazonas
Para
Bahia
Pernambuco
Quito
Lima
Valparaiso
Santiago
BUENOS AIRES
MONTEVIDEO
Rio de la Plata
Porto Alegre
San Paulo
Falkland Is.
South Georgia
Galapagos Is.
Guatemala
EQUATOR
TROPIC OF CAPRICORN
NEW YORK TO PARA
NEW YORK TO PERNAMBUCO, BUENOS AYRES
LIVERPOOL TO PARA & MARANHAO
MONTEVIDEO TO VALPARAISO
MONTEVIDEO TO MAGELLAN STR.
CAPE HORN TO RIO DE JANEIRO
HAMBURG TO CALLAO VIA PUNTA ARENAS
Cable and Telegraph Lines
Railroads
Steamship Routes, Distances in miles
Copyright by The American Company

are repeated: the westerly winds giving to that coast a mild, equable temperature and heavy rainfall, while the Andes bar nearly all the moisture from the east, and the great southern plains or pampas are a relatively arid steppe.

Taking the continent as a whole, the rainy zone is disproportionately extended in America; and as it stretches over all the zones, the vegetation is remarkably diversified, from the lowly moss of the north to the lordly banana of the tropics. The giant chain of the Andes everywhere rises above the snow-line. From the sterile Peruvian coast, burned by tropical heats, one can look up to summits covered with perpetual snow and ice; and one may climb from the gigantic equatorial vegetation of Quito to heights where only the condor testifies to the existence of organic life as he wings his flight over snow-fields and glaciers. In Peru the culture of cereals is carried on at the height of 12,000, and near Quito at 9,000 feet. The north and south of America have the same length of day; but in the seasons which depend not merely on astronomical but on a variety of local causes, the analogy does not hold and very remarkable discrepancies appear. Thus, for example, the east coast of Brazil has the rainy season from March to September, while Peru, lying under the very same latitude, has it from November to March. Within the tropics the transition from the rainy to the dry season takes place almost instantaneously; but in receding from the tropics on either side the change of seasons becomes more and more gradual till at last, in the polar zones, nature, bound in icy chains, affords for living existence only a short awakening out of a long winter sleep.

(See publications of the United States Weather Bureau, the Canadian Meteorological Office, and the Mexican Weather Service; Greely's 'American Weather,' 1888.)

Flora.— The sections of cultivation have been dealt with already and we shall consider here only the indigenous features. From north to south the general succession is as follows:

The surface-thawed arctic tundra bears only reindeer-moss, blossoming weeds in its brief hot summer, and dwarf willows. From about the Arctic Circle to the southern coast of Alaska, James Bay and the North Saskatchewan, we find shrubby plants, most of them yielding berries; then the universal wood-of-all-work, the famed "Alaska spruce," with clumps of birch and alder: these at first sparsely, then forests of conifers,— larger spruces, pine, hemlock, and fir. This coniferous growth extends in enormous volume down the cool wet Pacific slope to central California; the giant redwoods and sugar-pines, etc., and the huge sequoia, the largest and oldest plant on the earth, being famous everywhere. Eastern Canada is forested with similar coniferous species; so is the United States through Michigan, Wisconsin, and west to Minnesota, to southern Missouri and northwestern Arkansas, and to northeastern Texas and the Indian Territory. The central United States has predominant deciduous (hardwood) trees, such as the oak of many varieties, the beech, maple, elm, chestnut, black walnut, hickory, ironwood, pepperage, red mulberry, etc. In the southern States the yellow pine holds foremost place. The characteristic forms of the southern States are the magnolia, palmetto, tulip-tree, plane-tree, pecan, etc., with the cypress everywhere in the swamps. The Cordilleran woods are chiefly conifers, and on the mountains; on the plains and in the valleys are the yucca, cactus, etc., whose dense, thorny growth is termed chaparral. The wild picturesqueness and even grotesqueness of the cactus forms is noted; and it furnishes food for animals that would otherwise starve on the arid steppes. The north Mexican plateau has little wood except on the mountains. Southward vegetation blends with the tropical forms, and in Central America and the Antilles the most valuable trees are the mahogany and boxwood, and of vegetable products vanilla and ginger.

In South America there is no arctic region; but the great differences in altitudes and the water supply give it a wide range of native production. The immense rainfall and steady tropic heat of the north shore along the Caribbean and in the Magdalena valley create a profuse tropical flora on the lowlands, changing to palms, bamboos, tree-ferns, etc., on the higher levels, and coniferous trees on the mountains. Along the Orinoco the llanos, plains with immensely tall grasses and great single trees, take the place of forests. The vast selvas or swamp forests of the Amazon occupy the heart of the continent. These colossal tropic jungles, often formed into an almost impenetrable web by multitudes of creeping and climbing plants, contain an almost unexploited variety of magnificent trees with the most beautiful ornamental woods,—as rosewood, cocabola, etc.,—products like india-rubber, brazilwood for dyeing, cinchona for medicine, etc. Dense forests of cinchona overshadow the mountain terraces of Quito. South of the selvas are the forests of Matto Grosso, the great Brazilian province east of Bolivia; south of this again, and of the Bolivian Cordillera, is the Gran Chaco, or "great round-up," from the Paraguay to the Andes,— a region of three to five hundred thousand square miles, largely plains, but with heavy forests including the wax-palm, and with tree-like thistles on the lower plains. Now begin the pampas of the lower La Plata, which are fine grassy plains in the northern part, but in south Argentina and Patagonia become semi-arid steppes. The western strip has already been dealt with.

(Gray's 'Synoptical Flora of North America,' 1886-97; Heller's 'Catalogue of North American Plants North of Mexico,' 1900; Sargent's 'Silva of North America,' 1890-1; Britton and Brown's 'Illustrated Flora of the Northern United States, Canada, and the British Possessions,' 1896-8; Berg's 'Physiognomy of Tropical Vegetation in South America,' 1894; Rusby's 'Enumeration of Plants Collected in South America,' in 'Torrey Botanical Club Bulletin,' Vols. XV., XX., XXII., XXV., XXVII.).

Fauna.— The distribution of animal life in America proves by itself what was probable on geologic and physiographic grounds, that the proper division between the two continents is not at the Isthmus of Panama, but at either Nicaragua or Tehuantepec, and that the junction was relatively late. Zoologically considered South America includes also not only Central America and the Antilles, but the Mexican plains and coasts east, west, and south of the plateau of Anahuac. The faunæ of the two con-

tinents have almost no common feature. Furthermore, the North American species are in many respects closely allied to the North Asiatic, while the South American mammalia and birds have but slight affinities to those of any other section of the world, and those of the most general kind; fully four fifths of its species being unknown outside its own limits. North America, with this proviso, in Sclater's and Wallace's classification, is Palaearctic in the arctic regions and for some distance south of the northern ocean and west of Hudson Bay, and Nearctic through the rest of its bulk; while South America, thus extended, is Neotropic. Some authorities, however, from the close affinities of the first two, group them together into one as Holarctic or Triarctic.

In North America, for instance, the fur animals are not very different from the Siberian kinds; the reindeer, moose (called elk in Europe), and bighorn are closely akin to Asiatic congeners; the bison belongs to the buffalo family; the cat family is represented by the panther and wildcat; the wolf family by various classes of wolves, and probably by the Eskimo dog; the bear family by several distinct sorts. The white goat has close foreign relatives; so have the beaver, marmot, rabbit, squirrel, and most of the other rodentia, the weasels, insectivora, bats, and others. The birds, reptiles, and amphibia are nearly all identical in family with Old World groups, and often in species. The fresh-water fish and mollusks of the cold regions of both are generally akin, and sometimes the same, though in the great rivers of the southern half many new forms have developed, the river mollusks being much more numerous and specialized in the United States than in any other part of the world. But there are very notable individual forms. The North American "great cat," variously called panther, catamount, cougar, puma, mountain lion, American lion, etc., has long been specialized in this region; the musk-ox and the skunk are our own, as are the pronghorn and the gopher. And there are still more striking absences where all analogy would lead us to expect strong representation. The horse, camel, and rhinoceros originated in North America as late as Tertiary times, but have entirely disappeared. There is but one marsupial, the opossum, no antelopes, and but one genus of native swine, in Texas and Arkansas.

South America shows a new world. Out of 10 orders of mammalia with 33 families which it contains, 13 families are confined exclusively to it. All its families in two orders, the Primates (monkeys) and Edentates (armadillos, sloths, and ant-eaters), are its own, and five of its nine families of rodents; while of the *Chiroptera* (bats), one family, the *Phyllostomidæ*, which includes the vampire bats or blood-suckers, is peculiar to it. Its deficiencies are equally notable, though less so in some respects than of the northern continent, as it lacks none which originated there. The horse family group is represented only by the tapir, the ruminants only by the llama, and the bears only by the Andean bear of Chile and Peru. There are no Ungulates but a small deer and one genus of swine, no members of the weasel or civet families, and only two small genera of insectivores. The birds, instead of having a wider range as might be thought, are still more individual: 23 families, including hundreds of genera, are exclusively South American, while only three out of its 118 genera of humming-birds, one of its 43 genera of tanagers, eight of its 70 genera of tyrant flycatchers, one of its 14 genera of macaws, four of its 13 genera of pigeons, one of its 12 genera of *Cracidæ* (curassows, etc.), two of its 11 species of goatsuckers, etc., have any habitat beyond itself. Of its wading and swimming birds, 18 of its 24 genera are peculiar to it. The reptiles are much less specialized, only four out of 60 genera being entirely individual, and those of lizards; the species, however, are more peculiar than this would indicate, the boas and scytales being distinctively South American, and the iguana practically so, though known somewhat north of this region. The waters naturally are much less specialized. Of the amphibians only three out of 16 genera are local. The fishes have four families and 17 genera, of which one family with its one genus, and a genus of another, are peculiar to the South American, the resemblances being mainly to the African families. The sirenoids represent extremely ancient forms. The insects are also not so different in form as might be anticipated. But this view understates the specific variations, for on the whole South America is a zoological land apart.

(See 'The Standard Natural History,' Boston, 1885; Alfred Russel Wallace, 'The Geographic Distribution of Animals,' 1876; Merriam's 'Geographic Distribution of Life in America,' in Vol. VIII. of 'Proceedings of the American Biological Society.' For special portions, Cope's 'Crocodiles, Lizards, and Snakes of North America,' in United States National Museum Report, 1898; Apgar's 'Birds of the United States,' 1898; Goode's 'American Fishes,' 1888; Edwards' 'Butterflies of North America,' 1868-88.)

Political Divisions.— The independent States of both North and South America are all republican in government, though it was only in 1889 that Brazil became a republic. The continent is politically divided as follows:

INDEPENDENT REPUBLICS.

	Capitals.	Sq. m.	Pop. 1900.
North America —			
U. S. Proper	Washington	3,025,600	76,303,387
Alaska	Sitka	590,884	63,592
Hawaii	Honolulu	6,449	154,001
Porto Rico	San Juan	3,530	953,243
Total		3,636,463	77,474,223
Mexico	Mexico	767,316	13,570,545
Central American States —			
Guatemala	New Guatemala	46,774	1,574,340
Honduras	Tegucigalpa	46,250	420,000
Salvador	San Salvador	7,225	915,512
Nicaragua	Managua	49,200	407,000
Costa Rica	San José	22,996	309,683
Total		172,445	3,626,535
Cuba	Havana	41,655	1,572,797
Haiti	Port au Prince	10,204	1,211,625
San Domingo	San Domingo	18,045	700,000
South America —			
Colombia	Bogotá	504,773	4,600,000
Venezuela	Caracás	593,943	2,444,816
Ecuador	Quito	125,000	1,271,000
Peru	Lima	695,733	4,609,999
Bolivia	La Paz	567,430	2,300,000
Chile	Santiago	290,829	2,712,145
Argentine Republic	Buenos Ayres	1,113,849	4,794,149

Copyright, 1903, by Rand, McNally & Company.


CARIBBEAN SEA
Gulf of Darien
Gulf of Panama
Amazon R.
PACIFIC OCEAN
ATLANTIC OCEAN
Rio de la Plata
Gulf of San Matias
Bay of San Jorge
SOUTH AMERICA
(Relief)
SCALE
Dark Brown indicates highest land
Dark Blue indicates deepest water

Uruguay	Montevideo	72,210	900,600
Paraguay	Asuncion	157,000	660,000
Brazil	Rio Janeiro	3,218,130	18,386,815
Total		7,338,897	42,679,524

EUROPEAN DEPENDENCIES AND POSSESSIONS.

British —

	Capitals.	Sq. m.	Pop.
Dom. of Canada	Ottawa		
Ontario	Toronto	219,650	2,167,978
Quebec	Quebec	344,450	1,620,974
New Brunswick	Fredericton	28,100	331,093
Nova Scotia	Halifax	20,550	459,116
Prince Edward I.	Charlottetown	2,000	103,258
Manitoba	Winnipeg	64,066	246,464
Assiniboia	Regina	89,340	
Saskatchewan	Prince Albert	108,000	145,000
Alberta	Calgary	99,255	
British Columbia	Victoria	383,300	190,000
Unorganized Territories		2,141,289	74,484
Newfoundland	St. Johns	42,200	210,000
Labrador (dep. Newf.)		120,000	4,200
Bermudas	Hamilton	20	16,423
British Honduras	Balize	7,562	35,226
Bahamas	Nassau	5,450	53,000
Barbados	Bridgetown	166	192,000
Jamaica (including Turk's Island	Kingston	4,424	745,104
Windward Islands	St. George's		
Grenada and Grenadines	St. George's	145	72,000
St. Vincent	Kingstown	132	41,054
St. Lucia	Castries	233	48,650
Leeward Islands	St. John's		
Antigua (inc. Barbuda and Redonda)	St. John's	170	39,000
Virgin Islands		58	4,639
Dominica	Roseau	291	26,841
St. Christopher (St. Kitts)	Basseterre	65	32,000
Nevis	Charlestown	50	15,000
Anguilla		35	4,100
Montserrat	Plymouth	32	13,000
Trinidad	Port of Spain	1,754	260,517
Tobago	Scarborough	114	21,400
British Guiana	Georgetown	120,000	283,278
Falkland Islands	Stanley	6,500	1,789
Total		3,809,401	7,457,588

French —

St. Pierre	St. Pierre	10	5,700
Miquelon	St. Pierre	83	550
Guadeloupe, etc	Basse-Terre	583	165,899
Martinique	Fort de France	381	187,692
French Guiana	Cayenne	30,450	30,300
Total		31,507	390,141

Danish —

Greenland (as colony)		46,740	10,516
Danish West Indies	Charlotte Amalie		
St. Croix or Santa Cruz	Christiansted	84	19,783
St. John	Charlotte Amalie	21	984
St. Thomas	Crux Bay	33	14,389
Total		46,878	45,672

Dutch —

Curaçao	Willemstad	403	51,524
Dutch Guiana or Surinam	Paramaribo	46,060	66,490
Total		46,463	118,014

Total North and South America settled or under government, sq. m. 15,919,274; pop. 148,846,664.

FORREST MORGAN,
Connecticut Historical Society.

America, Discovery and Colonization of. The effective discovery of America was a gradual process, made possible by the first westward voyage of Columbus across the Atlantic and developed by attempts to determine the relation of the lands thus encountered to the Asiatic continent. The body of legends concerning European or Asiatic contact with America prior to the 15th century bears witness only to a vague impression of or conjecture at the existence of land in the western part of the Atlantic Ocean, which led to nothing effective in the way of confirmation of such conjecture or occupation of the territory. The contact by the Norse colony in Greenland in the 11th century with the shores, probably of New England, which the Northmen knew by the name of Vinland, led to nothing more than occasional resort to certain of its facilities such as timber, and cannot be regarded as a discovery in any complete sense. Nothing can detract from the unique distinction of the expedition of Columbus in 1492. The cosmography of his time was in error as to the size of the earth and consequently underestimated the distance intervening between the western limit of Europe and the eastern shores of Asia. But this error could in the nature of things only be brought to light by an actual test by a westward voyage across the Sea of Darkness. This test it is the sufficient glory of Columbus to have furnished and its importance for cosmography cannot be overestimated. Nevertheless, in its relation to America alone, discovery in the complete sense was rather made possible, than achieved by Columbus.

It was under the auspices of the Atlantic States of Europe that development of the results of this voyage was carried on, and of these Atlantic States, Spain and Portugal at first took the leading part. At the time of Columbus' great voyage, Portugal had nearly completed the development of the possibilities of an eastward maritime route to the Oriental trade regions, the goal of maritime endeavor. The Spanish patronage of Columbus naturally led the Spanish Crown to claim for the westward approach to the Indies, thus made possible under its auspices, the same advantages which papal action had secured for Portugal in connection with the eastward route. By a papal bull of 25 September 1493, superseding those on the subject previously issued, enterprise upon the ocean was declared open to both Spain and Portugal, with the understanding that Spain should refrain from infringement upon the Portuguese monopoly of the African coast by using only the westward approach to the Indies. By the Convention of Tordesillas, 7 June 1494, the line 370 leagues west of the Cape Verde Islands was set by the two nations themselves as a division between their respective areas of maritime activity.

Spanish voyages between 1493 and 1502 now skirted most of the island and continental shores of the Caribbean Sea and the Gulf of Mexico, without, however, making much progress in elucidating the connection between these regions and the Asiatic continent, with which they were still somehow supposed to be connected. In the meantime, by the Cabral voyage to Brazil in 1500 and those of the Cortereals to Labrador and Newfoundland in 1500–1502, Portugal found an interest in westward voyages, for she claimed that not only Brazil, but also the regions in the vicinity of the fishing grounds in the north were east of the line of demarcation. The expeditions of Vespucius, Coelho and Jaques, 1501–1503, not merely satisfied Portuguese curiosity as to the extent of their possessions accessible by the westward voyage, by

establishing the southwestern trend of the Brazilian coast, but, what was very much more important, by establishing the continuance of this land mass to a point as far south as the latitude of the southernmost point of Africa, practically ensured the conviction that here was a New World. This was a land mass, insular or peninsular in its connection with Asia on the north, of such extent as practically to constitute a part of the world co-ordinate with Europe, Africa, and Asia. It was to the New World, as thus conceived, that the name America, perhaps a little more than half seriously, was proposed by friends of Amerigo Vespucci in 1507, to be applied, and the name thus applied was but very gradually extended, as the truth became known, to the whole double continent. Spain's great efforts in exploring voyages as distinguished from land expeditions into the interior, were now concentrated upon the search for a strait through, or a passage to the south of, the lands revealed by the voyages since 1492. This was in response to the epoch-making voyage of da Gama in 1497. More accurate acquaintance with the extent of the Asiatic continent developed by Portuguese activities in the Far East subsequent to the voyage of da Gama was a favorable condition for such attempts as the Spaniards were making, and the voyage of Magalhaes in the service of Spain in 1519–22 to the south of the New World revealed the extent of the waters lying between it and the Asiatic continent. This was a fundamental fact, knowledge of which was in large outline logically sufficient to establish the separate continental character of the territory brought to knowledge since 1492. Appreciation of this significance of Magalhaes' voyage was slow in developing, however, and not until after exploring conquests of the western shores of the continent from bases on the eastern shore, like the conquests of Mexico and Peru by Cortez and Pizarro in 1519–21 and 1531–33, Almagro's and Valdivia's Chilian expeditions in 1535–40, and expeditions like those of Cortez and Alarcon and Coronado to Lower California and up the Colorado River in 1526–40, that the outline of the continent on its western shore was traced out as far as Southern California. The coast north of this region was only reached and effectively made known by a succession of voyages covering a considerable space of time and headed by representatives of different nations. Most prominent in this enterprise were the expeditions of Drake in 1577–80, which probably reached the northern California coast; Bering, the Russian, in the strait bearing his name and on the Alaskan coast, in 1741, and Vancouver on the coast of what is now British Columbia in 1792. The eastern shore of the continent — unless we include the voyage of Gomez from Labrador to Florida in 1525, which was not followed up — was outlined by Spain only as far north as Chesapeake Bay, the remainder being the scene of French and English activity after the Spanish power was becoming embarrassed in Europe.

After the voyage of Magalhaes in 1522, Spanish interest in the New World concerned itself rather with the task of exploring the interior of the regions whose boundaries Spanish voyages had skirted, than with further extension of the lines of inclusion. The glittering success of Cortez in Mexico in 1519–21 was responsible for many attempts in imitation of such an achievement, and in the course of these attempts much knowledge was attained of the conditions in the interior of the continent. Pizarro's conquest of Peru led on to the exploration and attempted conquest of Chile and to the crossing of the Andes and the descent of the Amazon by Orellana in 1541. The La Plata system was explored by Sebastian Cabot and Diego Garcia in 1527–30. In the northern continent, Florida had been discovered by Ponce de Leon in 1512 and proved a part of the continent by Pineda, who also made acquaintance with the Mississippi in 1519. In the course of the wandering of such parties as those led by de Leon, Narvaez, Cabeza de Vaca and Coronado from 1512 to the middle of the century, much of the interior was seen as far north as the Missouri and Ohio systems, but only the extreme southeast and southwest portions, that is, California and Florida, saw any attempt by Spain to occupy the territory thus wandered over. The task of administering and exploiting what she already had was sufficient to absorb what energy could be spared from European occupations.

France and England, in the meantime, were becoming less and less inclined to respect the claims of Spain in any direction not backed up by present physical force, and more and more inclined to take up a line of aggression in maritime endeavor, not only for the sake of weakening the general position of Spain, but also because of the stirrings of individual enterprise within their own populations. It was only under these circumstances that England began to make use of the claim based upon the Cabot voyages of 1497–98. Conditions inclining the government to a policy of respect for the claim of either Spain or the Pope were now wholly changed, and as against any right to territory west of the line of Tordesillas, England pursued the policy that occupation must, within a reasonable time, be added to discovery to constitute a valid title to territory in the New World. According to this criterion, the achievements of England and France in the 16th century can only be regarded as preliminary or preparatory in character. In each case internal strife at home and the exigencies of the European situation prevented the achievements of discovery and incipient settlement from being followed up. Nevertheless they served to reveal in an effective way that portion of the continent in which conditions for transplantation of European institutions and life were most favorable. The stretch of shore left unoccupied was comparatively small and the great work of France was extensive, and rapidly spread over the interior accessible by water-routes from the shore. While England's great work was the permanent and slow-expanding settlement of the strip between the coast and the mountain-barrier of the Alleghanies.

In 1524 Verrazano, a Florentine in the service of France, coasted from North Carolina to Newfoundland, and in 1534–41 the first French attempt at settlement was made under Cartier and Roberval, and though it was not at this time maintained, the foundation was thus laid for the French claim to the territory of the Saint Lawrence system. Attempts to invade the undoubted sphere of Portugal by Villegagnon in Brazil in 1555, and of Spain by Ribaut and Laudonniere in Florida and South Carolina in 1562,

were promptly suppressed. So that when, at the beginning of the 17th century Frenchmen were in a position to take up transatlantic activity once more, the Saint Lawrence basin naturally became the scene of their endeavors. From Port Royal in Nova Scotia in 1603, headquarters were shifted in 1607 to Quebec, and once established at one end of the great interior waterway system, and headed off from southward expansion by the hostility of the Iroquois, the line of least resistance led naturally to the interior by the west. These circumstances, coupled with the character of the emigrating population, account for the most signal achievement of the French in the New World — exploration of the continental interior. This went on coincidently with the process of colonization and thereby a fundamental characteristic of New France on the mainland was illustrated — the attempt by the government to nourish a true colony in eastern Canada, while the adventurous population, missionary, and fur-trader, overran the surface of the great interior. Trails were made by Nicollet in 1634 as far as the Illinois country by the Lakes and the Fox River route, by Radisson and Groseilliers in 1658–59 as far as Lake Superior and the Hudson's Bay region, by Joliet and Marquette in 1673 to the Mississippi. And by 1682 La Salle had opened up the connection between the Gulf of Mexico at the Mississippi's mouth and the Gulf of Saint Lawrence. By 1699 a French settlement was planted in Louisiana and in 1718 New Orleans was founded.

With England, the order of proceedings was different. Exploration of new regions was a preliminary to their filling up with settlers and bursts of exploring activity occurred in the intervals of the great stages in the process of colonization. The Cabot voyages gave her the basis of the claim to the continental shore to the north of Florida, but her first exploring activities were in connection with the search for the northwest passage to the Orient by such commanders as Davis and Frobisher in 1576–78 and with the attempt to occupy Newfoundland by Gilbert in 1579. With the career of Raleigh, the English maritime enterprise takes definite beginning in the colonizing line with the attempt at Roanoke in 1585, and from then till well into the 18th century English exploring activity was mainly concerned with the coast between Florida and Newfoundland, the basis of her colonies on the main. This was as characteristic of the English career in the New World as the French method of rapid and extensive spread from an undeveloped base. In the course of occupation of the coast, the English found themselves preceded in the strategic regions of the Hudson and Delaware valleys by the Dutch, and falling back on the principle of prior discovery alone, which, as against Spain, she had disregarded, made conquest of the New Netherlands settlement in 1664, as an invasion of the right to the whole, claimed by virtue of the Cabot voyages. British interest in the interior awoke in the 18th century, and, mostly under colonial leaders, British hinterland was extended to a hostile contact with the French claims to the interior based on discovery and exploration of the Saint Lawrence system. This being settled, by the elimination of New France from the continent in 1763, English exploring activity found its scene, after the separation of the seaboard colonies with their westward extensions to the Mississippi, in the extreme northern part of the continent, with the territory of the Hudson's Bay Company as the base. Here in the later years of the 18th century the early expedition of Verendrye to the Canadian Rockies by the Saskatchewan in 1741 through the interior of the Canadian Northwest was followed up by Hearne in 1770 and Alexander Mackenzie in 1789.

The areas in the New World within which the colonizing activities of the European Atlantic States were carried on conformed in a general way to the scenes of their earliest contact and activity. Portuguese colonization in the New World was limited to Brazil, the only portion of the continent within the limits marked out by the line of Tordesillas. Spanish activity radiated from the Caribbean archipelago in all directions and included the greater part of habitable South America, Central America, and the southern portion of the North American continent. French colonies were to be found among the West Indies, but the greatest extent of French settlement was in the neighborhood of the Saint Lawrence system, while the English, late comers as they were, occupied strategic points among the islands and stretched along the continental shore from Florida to the Kennebec.

In the list of participators in the work of colonizing the New World there must be added to the European Atlantic States already mentioned as conspicuous in discovery and exploration, Holland and Sweden. But the brevity of the duration of these attempts hardly entitles them to a place of equal significance with the other four as colonizers in America. The Swedish colony founded in 1637 on the banks of the Delaware was regarded by the Dutch as an intrusion on their rights and fell victim to Dutch conquest in 1655. The Dutch enterprise on the Hudson and Delaware was in turn held by the English as equally an intrusion on English North America and the Dutch were dispossessed in 1664 by the same means as they had themselves employed upon the Swedes. During their development of New Netherlands the Dutch were not successful in planting the colony firmly on an agricultural basis, the fur trade proving attractively profitable. A system of colonial government in too close dependence upon a clumsily working confederate government at home and a system of local government which repressed individual initiative retarded the development of the colony. A few islands in the West Indies and a small stretch of the northeastern coast of the South American continent still remained — and do yet — as Dutch colonies in the New World.

Portugal began her American colonization in 1531 in Brazil, but was unable to give it the requisite attention until the 18th century. In the meantime the comparative freedom from restraint enjoyed by the colonizing population had exercised a developing effect, and, putting in practice lessons in regard to the exploitation of a tropical colony learned elsewhere, Portugal developed a colonial establishment stable enough to afford a refuge for the House of Braganza during the period of Napoleonic occupation of the Iberian peninsula. In 1821, the Brazilians with the concurrence of their regent, himself of the royal house of Portugal, proclaimed their

independence from the Crown of Portugal, and this independence was subsequently ratified by treaty.

The Spaniards began colonizing with the second voyage of Columbus and the islands of the Caribbean, particularly Haiti and Cuba, became the scenes of an exploitation of the superficial riches of the tropics which served as bases for exploring conquests to the territory of the mainland. The policy of Spain towards her wide domain in the New World, as worked out in the 16th century, not in abstract theory, but in combination of theory with practice, was but little more illiberal, but considerably less intelligent than that of other States. But the climate of the part of the New World falling to them was not conducive to the steady, strenuous persistence necessary for the building up of permanent wealth-producing communities. Nor were the original characteristics of the colonizing population calculated to make success in such a career likely. The natives were not able to offer stubborn resistance to the rapidly moving enterprises of the conquistadores. A certain tendency to amalgamate with the natives — a tendency which weakened the stronger without strengthening the weaker race — did not prevent the evasion of the laws intended to protect the natives from the rapacity of their conquerors and to keep the two opponents of the official class in balance against each other. The too rapid early successes in the realm of military conquest and the easily won response to the search for the precious metals still further unfitted the Spaniard for what modern colonizing peoples are finding the most difficult of tasks — the intelligent exploitation of the possible economic resources of a tropical region where the available labor supply is for various reasons inefficient according to European standards. Nevertheless, though the Spanish dominance over such a great part of the New World could not guarantee prosperity to this Empire, it was rather the shock given by the Napoleonic attack on the mother country and its consequences on Spanish internal warfare than the inherent strength of the separate divisions of Spanish-America, that accounts for the revolt of the greater part of this Empire in the first three decades of the 19th century. And at the same time that political separation was taking place, Spain in Europe stood in such need of political help from England that a commercial invasion of Latin-American markets could not be prevented. With this once accomplished and the Napoleonic danger passed, the influence of England was publicly and privately used to obstruct all attempts from Spain to re-unite the scattered fragments of the once mighty power in America. The sluggish development, to call it by no worse a name, which characterized what remained to Spain of dominion in America between the Latin-American revolts and the wresting of Cuba and Porto Rico by the intervention of the United States in 1898 illustrates the degree of effectiveness of Spanish colonial policy according to modern economic standards.

French colonization in America received much attention from the home government and the French temperament was one adapted to success in dealing with the natives, and in amalgamation with them in preserving the elements of strength. But on the other hand the over-zealous and intemperately exercised interference from home frequently nullified all the good that the lavish furnishing of assistance in materials and in military protection did to the fortunes of the colony. The climate was as excessive in its rigor as that of New Spain was in the opposite direction. The hostility of the Iroquois, fiercest of all the native tribes, obstructed expansion to a more favorable clime and made extensive use of a vast forest domain for the fur-trade a more easy and attractive program than the jog-trot business of intensive agriculture and the development of permanent communities on the frontier for which latter task lack of the habits of initiative in self-government unfitted the colonizing population. The only colonizing material in the French people capable of developing such traits — the Huguenots — was peremptorily excluded from New France. So that when the English expansion had at length come into collision with the borders of the French forest preserve in the interior, New France on the continent was capable, by reason of the feudal and military force pervading its population, of effective resistance against the superior numbers of the English settlements co-operating but clumsily with each other. As between the French and British empires as world-units, however, there was soon no question of superiority, and France was definitively excluded from the continent as the result of the Seven Years' war (q.v.). The French possessions in the West Indies, acquired in various ways during the 17th century, remain to her, and make of her to that extent an American power.

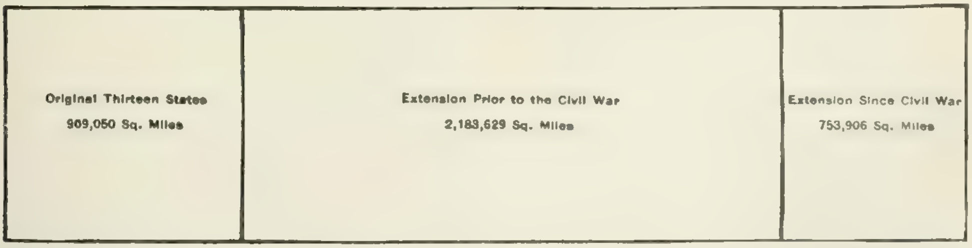
The colonizing work of England in America belongs to the colonial period of United States history (q.v.). In broad outline, her policy toward her American domain was one which, whether with design or not, allowed wide scope for individual and local initiative. The English population afforded good colonizing material. The Indians gave no such serious trouble as did the Iroquois in the case of the French in the early stages of their colonizing. Defense against European attacks upon the colonies was effective. As builders of settlements in the New World, the English were eminently successful. In devising, or at any rate, applying a system of political connection between the home government and the colonies, the English reached an unfortunate place in their internal political development coincidently with a critical stage in the relations of colonies and mother country. The strain at that time and under those circumstances brought upon colonial loyalty proved too great and by the separation of the 13 Atlantic seaboard colonies, Great Britain's power in the New World was cut down to control of certain important West India islands and the area so recently wrested from France. Under the new spirit of the British Empire which appeared i the 19th century, these possessions have been s developed and bound in sentiment to the inter ests of the mother country that Great Britain stands second only to the United States as an American power.

Consult: Winsor, 'Narrative and Critical History'; Fiske, 'Discovery of America'; Payne, 'Cambridge Modern History' (Vol. I.); Morris, 'The History of Colonization'; Roscher, 'The Spanish Colonial System.'

Charles Worthen Spencer,
Professor of History, Colgate University.

America, United States of. Half of the entire land area of the world, estimating it at 51,410,700 square miles, is in the possession of four nations, one of these four being the United States of America (q.v.). The territory of this nation covers 3,846,595 square miles. Each of the three other nations possesses a greater area, the British empire (q.v.) covering 8,964,884 square miles; Russia (q.v.), 8,660,395; and

China (q.v.), 4,277,170. The territory of the United States is all contiguous, with the exception of outlying insular possessions. That of the British Empire is widely scattered. Russia and China have each the advantage of contiguity of territory, but Russia is one of the least developed of civilized nations, while China as yet has scarcely begun the march of modern progress. The history of the United States has been marked by a territorial expansion (see UNITED STATES — TERRITORIAL EXPANSION) which is wonderful on account of its rapidity and the fact that it is the result, almost entirely, of peaceful acquisition, a very large proportion of the acquired territory having been ceded by other nations, as in the case of the Louisiana



Purchase in 1803, and of the Alaska purchase in 1867, the first of which nearly doubled the area of the country at that period. The 13 British colonies which began the war for independence in 1776, and which Great Britain was forced to recognize as the United States of America in 1783, comprised a territory of 909,050 square miles. Briefly told, the story of expansion follows: By the Louisiana Purchase (q.v.) in 1803 the United States acquired from France, for $15,000,000, a territory covering 875,025 square miles. Oregon, 288,689 square miles, was acquired under what is known as the Florida treaty (q.v.) in 1819; and the same year witnessed Spain's cession of Florida, 70,107 square miles, for a consideration of $5,000,000. Texas, an independent republic with 389,795 square miles of territory, was peacefully annexed in 1845. Mexico ceded 523,802 square miles of territory in 1848, for a consideration of $15,000,000, and the payment of claims held by American citizens against the Mexican government, amounting to $3,250,000. By the Gadsden Purchase (q.v.) of 1853, so called because it was negotiated by James Gadsden, United States minister to Mexico, 36,211 square miles, forming the southern part of the present territories of Arizona (q.v.) and New Mexico (q.v.), were purchased from Mexico for $10,000,000. Thus, down to the period of the Civil War of 1861–5, the area of the United States had been increased by 240 per cent. The aggregate amount paid for ceded territory, including $499,768 interest on the $5,000,000 paid for Florida, was $48,749,768. After the Civil War Russia ceded Alaska (q.v.) in 1867, and the United States secured 599,446 square miles for $7,200,000. The Republic of Hawaii (q.v.) declared for annexation in 1897 and now forms part of the United States as one of the territories. Its area is 6,740 square miles. Following the nation's success in the Spanish-American war of 1898 it acquired in that year the island of Porto Rico, 6,740 square miles; Pine Island, 882 square miles; and Guam Island, 175 square miles. In 1899 the Tutuila group of the

Samoan Islands, 73 square miles, was acquired; and Spain ceded, in consideration of $20,000,000, the archipelago known as the Philippine Islands (q.v.), which has an aggregate area of 143,000 square miles. The total extension of United States territory during the century amounted to 2,937,535 square miles, a territorial growth of 323.14 per cent, at a cost for ceded territory of $75,949,768.

Multiplication of constituent States has been fully as rapid as extension of territory, the vast regions acquired being opened up to settlement under conditions inviting large immigration. The first of the new States, however, was Vermont, whose territory had been claimed for years by New York and several of the New England States. Vermont was admitted to the Union in 1791. Two other States have been created within the territory covered by the

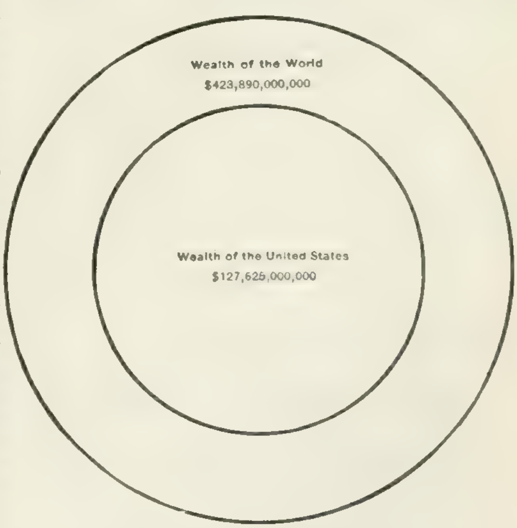
original 13, namely, Maine, detached from Massachusetts and admitted in 1820; and West Virginia, formerly included in Virginia, which State, already divided physically into two sections by the Alleghany Mountains, was divided in sentiment at the beginning of the Civil War, the western section adhering to the Union cause, and receiving recognition as a State in 1863. The full list of States added to the original federation, together with the respective dates of admission, follows: Vermont, 1791; Kentucky, 1792; Tennessee, 1796; Ohio, 1803; Louisiana, 1812; Indiana, 1816; Mississippi, 1817; Illinois, 1818; Alabama, 1819; Maine, 1820; Missouri, 1821; Arkansas, 1836; Michigan, 1837; Florida, 1845; Texas, 1845; Wisconsin, 1848; California, 1850; Minnesota, 1858; Oregon, 1859; Kansas, 1861; West Virginia, 1863; Nevada, 1864; Nebraska, 1867; Colorado, 1876; North Dakota, 1889; South Dakota, 1889; Montana, 1889; Washington, 1889; Idaho, 1890; Wyoming, 1890; Utah, 1896.

Growth of population rather than acquisition of territory has been, of course, the occasion for the creation of States. With a few exceptions all of the States admitted to the Union were primarily organized with territorial governments, responsible to the federal authority at Washington, and remained territories until possessed of population sufficiently large to justify statehood. The first census of the United States, taken in 1790, showed a total population of 3,926,214, which exceeds by less than half a million the population of New York city, as shown by the census of 1900, and which is probably exceeded by the population of that city in the present year — 1904. The total population of the country in 1900 was 76,305,387. The increase, as shown by each decennial census, ranged between 36.4 per cent and 20.7 per cent, the general tendency being toward a reduced percentage as the country grows older and becomes more thickly settled. The average decennial increase from 1790 to 1900 is 30.9 per cent. Following are the figures showing the population at the close of each decade: 1790, 3,926,214; 1800, 5,308,483; 1810, 7,239,881; 1820, 9,638,453; 1830, 12,866,020; 1840, 17,069,453; 1850, 23,191,876; 1860, 31,443,321; 1870, 38,558,371; 1880, 50,189,209; 1890, 63,069,756; 1900, 76,305,387. The population in 1904, as estimated, is about 84,000,000.

Immigration from foreign countries has naturally been a large factor in the increase of population. During the period from 1821 to 1850 the total number of immigrants arriving in this country was 2,455,812. Of this number 1,038,824, or 42.3 per cent, were from Ireland, while Great Britain sent 367,933, making the

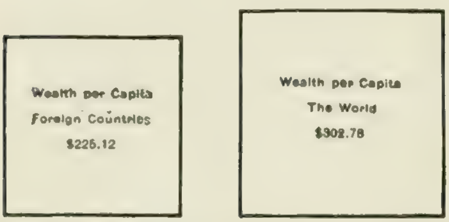
total contribution from the United Kingdom something more than 57.2 per cent of the entire foreign addition to the population of the United States. The great tide of German immigration began during the same period, the number of German immigrants being 593,841. There was also a considerable influx of the Scandinavian element, Norway, Sweden and Denmark send-

ing 16,966. Italy had made a small beginning with 4,531; and there was a mere driblet of 1,393 from Russia and Poland. Canada (q.v.) and Newfoundland (q.v.), which have supplied a large and valuable element of the population, began their contributions during this period with 57,624. Of the 2,598,214 immigrants who arrived during the decade, 1851–60, Queen Victoria's subjects constituted 51.5 per cent, not counting the 59,303 who came from Canada and Newfoundland; there were 914,119 from Ireland and 423,974 from Great Britain. Germany outnumbered Ireland in her representatives, sending 951,667. The Scandinavian countries sent 24,680; Italy, 9,231; and the Sclavonic countries, 1,621. During the ten years from 1861 to 1870 the tide of immigration fell off to 2,314,824, owing largely to the conditions existing here as a result of the Civil War. The quota from England and Scotland, however, showed a very large increase, the figures being 606,896; Canada and Newfoundland sent 153,871, as against 59,303 during the preceding decade; the Scandinavians numbered 126,392, an increase of more than 500 per cent; the Italians made a noteworthy increase with 11,728, while Russia and Poland's contingent increased to 4,536. This decade brought the first perceptible wave of the large tide which has flowed from Austria-Hungary, the number from that country being 7,800. While the German and Irish immigrants were greatly decreased in number they constituted a very large proportion of the whole, the Germans leading the list of nationalities with 787,468, and the Irish coming third with 435,778. An increase of nearly half a million immigrants is shown by the record for the ten years from 1871 to 1880, the number for that decade being 2,812,191. Germany continued in the lead, but with a further reduction in her figures. The German immigrants numbered 718,182. Ireland was a trifle better represented than in the previous decade, sending over 436,871, while Great Britain fell off to 548,043. The tide from Canada and Newfoundland was more than doubled, with 383,269 as the actual figures. Scandinavian immigrants numbered 243,016, or nearly double the number for the preceding ten years, while Austria-Hungary, Italy, Russia and Poland all made an immense increase in their representation, Austria-Hungary sending over to this country 72,960 persons; Italy, 55,759, and the Sclavic countries, 52,254. Immigration touched high-water mark in the record for the period including the years 1881–1890. The figures were 5,246,613. Germans led the list with 1,452,970. The immigration from other countries, in the order of the larger figures was: Great Britain, 807,357; Norway, Sweden and Denmark, 656,494; Ireland, 655,482; Canada and Newfoundland, 392,802; Austria-Hungary, 353,719; Italy, 307,309; Russia and Poland, 265,088. Something more than half of the immigration for the decade ending with 1890 was from Italy, Russia and Poland, and Austria-Hungary, in the order named. The Italians numbered 651,899; Russians and Poles, 602,010; Austrians and Hungarians, 592,707. Germany supplied 505,152; the Scandinavian countries, 371,512; Ireland, 300,179; Great Britain, 207,019; and Canada and Newfoundland only 3,064. Besides the countries named other countries have supplied from 180,355 to 374,703 immigrants for each of the periods, but those named have been selected for mention because of the influence which their emigrants must necessarily wield in determining the general character of the present population of the United States. The proportion of foreign born people to the entire population as shown by each census during the period covered is as follows: 1850, 9.7 per cent; 1860, 13.2 per



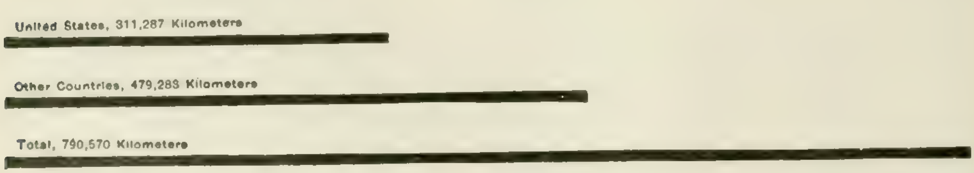
cent; 1870, 14.4 per cent; 1880, 13.3 per cent; 1890, 14.8 per cent; 1900, 13.7 per cent. The proportion of those native born, but of foreign parentage, can be shown only from 1870, as follows: 1870, 28.2 per cent; 1880, 29.8 per cent; 1890, 33.0 per cent; 1900, 34.3 per cent. See IMMIGRATION TO THE UNITED STATES.

By far the wealthiest country in the world, the United States possesses 30.5 per cent of the world's entire wealth, nearly double Great Britain's share, nearly two and a half times that of France, and more than three times that of Germany. The amount possessed by this country is, in round numbers, 127,625 millions of dollars, divided as follows: Farms, $20,710,000,000; railways, $11,300,000,000; buildings, $22,230,000,000; furniture, $8,000,000,000; merchandise, $7,815,000,000; bullion, $1,175,000,000; sundries, $19,695,000,000. The wealth per capita of the population is $1,519.34; that of the entire world being $302.78; and that of other countries than the United States, $225.12. The annual production of wealth as shown by the census of 1900 is $18,161,189,533, the manufacturing industries producing more than 70 per cent. The figures are: Mineral products, $1,257,732,261; farm products, $3,764,177,706; manufactures, $13,039,279,566. There is a large surplus production,



the preponderating element of which consists of cotton, breadstuffs and provisions, this finding a ready market in foreign countries and making the balance of trade very large in favor of this country. The total exports of merchandise for the fiscal year ended 30 June 1903 were $1,420,138,014, including foreign merchandise reshipped abroad to the amount of $27,906,377. Breadstuffs and provisions constituted about 35 per cent of the total value, and represented about 13 per cent of the farm product of the country. The total imports of merchandise for the same year were $1,025,751,538, the balance in favor of the United States being $394,386,476. See UNITED STATES — COMMERCIAL DEVELOPMENT OF THE; UNITED STATES — ECONOMIC DEVELOPMENT OF THE.

RAILWAYS OF THE WORLD IN 1900



Canals (q.v.) were an important factor in the early development of the country, and although they have been very largely superseded by the railways, they continue to assist materially the vast domestic commerce, and constitute a considerable element in transportation interests. Of the many canals which have been constructed in the United States 23 are ship canals, several of these being designed to make more available certain natural waterways of which they are extensions. There are 70 canals in all, including the new Illinois and Mississippi Canal, begun in 1902, but not completed in 1904. The total length of these artificial waterways is 3,627 miles. Most of the canals are intended for boats, barges and other light craft. Some of them have not been in use during recent years, but it is by no means certain that they will be abandoned, especially in view of the fact that the desirability of canal improvement has received recognition and the work of canal construction continues. The most important canal undertaking of all history is that of uniting the Atlantic and Pacific oceans by cutting through the isthmus connecting North and South America, a work which the United States government proposes to carry out with the most expedition possible. See PANAMA CANAL.

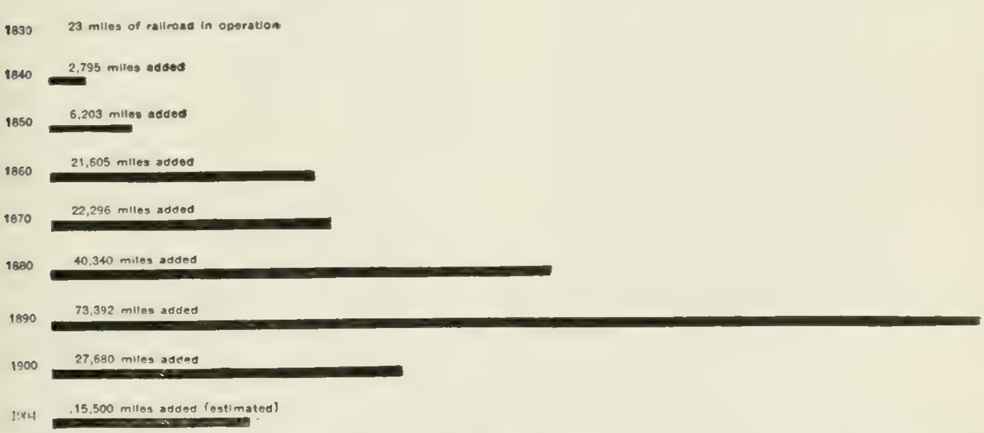
No country is the world possesses so many and so far-reaching railway systems as those of the United States. Statistics for 1900 show that of the entire length of railways in all parts of the world this country has considerably more than one-third — 39.3 per cent; in fact, the estimated number of miles of railway in operation in the United States in 1904 is 210,000. More than half of this mileage has been put in operation since 1880. The story begins with 23 miles of railway in 1830; and the additions have been as follows, by decades: 1840, 2,795 miles; 1850, 6,203 miles; 1860, 21,605 miles; 1870, 22,296 miles; 1880, 40,340 miles; 1890, 73,392 miles; 1900, 27,680 miles; 1901–4, 15,500 miles, estimated. The capital stock of the various railway companies aggregated, in 1904, $6,355,207,335; the gross earnings were $1,908,857,826; the net earnings were $592,508,512; and the total amount of dividends declared was $190,674,415.

The number of miles run by passenger trains was 429,014,116; the number of passengers carried was 696,949,925; and the total movement of passengers was 20,895,606,421. The number of miles run by freight trains was 548,680,595; the freight carried aggregated 1,306,628,858 tons; and the total freight movement was 17,292,198,079. Among speed records made the highest was 4.08 miles in 2 minutes, 40 seconds, on 18 Feb. 1901, near Screven, Ga. This is a speed of 107.09 per hour. A train maintaining this rate of speed could make a complete circuit of the globe at the equator in about 6½ days. See AMERICAN RAILROADS.

Means of communication bear as important a relation to the material development and prosperity of a country as do means of transportation (see RAILWAY TRANSPORTATION), and in the magnitude of telegraph and telephone interests the United States holds a leading position, while the post-office department of the government renders service which is excelled in only a few particulars by that of one or two foreign governments. On the other hand the postal affairs of the United States have their own points of excellence, and are subjected from time to time to such improvement as study and experience suggest. For the telegraph service of the country there existed in 1901 systems using 1,156,998 miles of wire, stretched over 219,938 miles of country. These afford means of instant communication with every part of the continent, and, by connection with the thousands of miles of submarine cable, with every country in the world. The number of messages transmitted in 1901 was 83,555,122. For telephone service there are 1,354,202 miles of wire, arranged in 508,262 circuits. They connect 1,348 exchanges and 1,427 branch offices. In addition to the public telegraph and telephone wires there is a large mileage of wires for both telegraph and telephone service which are the property of railway and other corporations, firms and individuals. The increasing use of the telephone has had an effect upon the growth of the telegraph interest, which nevertheless has a large share in the general increase which is felt by all enterprises identified with public convenience.

The history of the postal service of the United States from 1837 to the close of the fiscal year ended 30 June 1903, shows a public convenience maintained at an almost constant expense to the government in excess of the revenue derived from it. In the entire period the revenue exceeded the expenditures in twelve years only, namely, in 1837, 1838, 1839, 1840, 1842, 1843, 1844, 1845, 1849, 1850, 1851, and 1866. The revenue has grown from $4,945,668.21 to $134,224,443.24; and the expenditures from $3,288,319.03 to $138,784,487.97. While the service is conducted at a loss which has to be made up from the general revenues of the government, it must be remembered that the government itself employs it to a very large extent, free of postage, and thus the apparent loss is made up in large degree, if not altogether. For instance, the number of pieces of first class matter carried free for the government in the year 1902–3 was 153,233,677, which, at the minimum, represents $3,064,670.06 in postage. It is safe to add 25 per cent to this sum, which would make the amount $3,830,837.57, or within $729,207 of the deficiency for that year. The number of post-offices in the United States is 74,169, which number does not include the branch post-offices and sub-stations in large cities, of which there are several thousands. The force employed is immense, the free delivery in cities alone employing 19,542 carriers, and the rural free delivery routes an additional 15,119. The estimated number of pieces of matter passing through the mails during the year 1902–3 included 4,262,933,677 pieces of first class matter; 770,657,590 postal cards; 2,615,685,614 pieces of second class matter, or newspapers sent out from the offices of their publication; 1,053,637,057 pieces of fourth class matter, such as books, pamphlets, circulars, etc.; 93,380,005 pieces of fourth class matter, consisting of merchandise, etc.; 60,001,332 pieces of first class matter sent to foreign countries; and 31,171,413 pieces of all other matter sent to foreign countries; making a grand total of 8,887,467,048 pieces. These figures are beyond ordinary comprehension, but their vastness may be appreciated by estimating the size of each piece of matter mailed as that of an ordinary letter envelope. They would cover a plain about seven miles square, or larger than any ordinary town or city. If laid in a belt along the equator they would encircle the globe with a girdle 112 feet

RAILROAD EXTENSION BY DECADES



wide, or twice the width of an ordinary street. See POSTAL SERVICE IN COMMERCE.

The care and transfer of money is a matter of stupendous importance in a country of such vast wealth and productiveness. It rests mainly with the banking interest, as a matter of course, and this is another of the immense interests of the country. A great amount of money is transferred, however, through the money order department of the post-office, as well as through the express companies, which constitute another very large interest, and through the telegraph companies. The amount of money transferred through the money order department of the post-office during the fiscal year 1902–3 was $353,627,648.03. This aggregate represents mainly small transactions, and bears only a small proportion to the exchange business of the banks. The total number of banks in the United States in 1903 was 18,514, divided as follows: State banks and trust companies, 8,545; private banks, 3,902; savings banks, 844; national banks, 5,223. The total capital of these institutions was $1,652,700,362; and the total deposits were $11,246,266,227. See BANKS AND BANKING; MONEY.

In this presentation of the area, population, wealth and productiveness of the United States there is seen the largest development of material resources ever known under any form of government, and it is due in a great measure to the beneficial influence of that republican form of government under which the United States has grown to be one of the most powerful as well as the most prosperous of nations. The great interests of which mention has been made have been fostered and guarded by a government chosen by the voice of the people, and returning to the people at comparatively short intervals for a renewal of the authority confided to it. The character of the people becomes therefore a matter worthy of study. As already shown the growth of population has been considerably accelerated by immigration from other countries. The incoming elements have been widely distributed, and absorbed and assimilated to a marked degree, especially in the succeeding generation. Compulsory education (q.v.) of the young has been a potent factor in this work, and the privileges of citizenship together with religious freedom (see UNITED STATES — CIVIL AND RELIGIOUS LIBERTY IN THE) have had a full share in it. There is no country in the world where churches of every denomination are found in greater proportion to the population, and there is no country where so many large and self-supporting congregations of every denomination exist. While there is no government support given to any church, nor any legal enactments which interfere with a free choice of any religion or no religion, there is not only full protection for the peaceful worshipper, but also a recognition in law of the sacredness of the name of the Deity and of the day in each week set apart for worship. If more interest is taken in education than in religion it is because all intelligent classes regard education as an element of growth, while the religious class, to a large extent, regard it as a part of religion. Census reports show in their tables relating to illiteracy a reduction of illiterates for each decade since 1880, the proportion of illiterates falling off steadily among the native born population, including colored people and Indians. Between 1890 and 1900, however, there was increase in the proportion of illiterates among the foreign-born population, which can be easily traced to the changed character of immigration (q.v.). The percentage of illiteracy to the total population, even since the acquisition of the Philippine Islands, and the coming of more ignorant classes of immigrants, is much less than in any other country. For complete account of the history and development of the United States see under UNITED STATES.

FREDERICK W. WEBBER, M.A.

America, the American national hymn, written in 1832 by the Rev. Samuel Francis Smith. The air to which it is sung is that of the English national hymn, 'God Save the King,' the composition of Henry Carey in 1742. See NATIONAL HYMNS.

America, the name of the schooner yacht winning the international yacht race of 1851. The prize obtained, a silver tankard, has since been known as the "America's Cup." See YACHTS AND YACHTING.

America, Prehistoric. See ARCHÆOLOGY, AMERICAN.

American Academy of Medicine, an organization formed in 1876 to encourage the proper educational preparation of physicians. Membership about 1,000.

American Academy of Political and Social Science, an organization formed in 1889 to promote scientific study of the social sciences.

American Allspice. See CALYCANTHUS.

American Aloe. See AGAVE.

American Antiquarian Society, an association organized in 1812 at Worcester, Mass. The object of the society is the study and preservation of the antiquities of America, and the advancement of art and science throughout the world. Its library includes over 100,000 volumes, including a large number of the rarest Americana, very complete files of American newspapers, and a rich collection of manuscripts, and its 'Proceedings' have been published semi-annually since 1849. It maintains an important museum of antiquities, gathered in all parts of North, South and Central America.

American Anti-Slavery Society, The. See ANTI-SLAVERY SOCIETY, THE AMERICAN.

American Art. See ART, AMERICAN.

American Asiatic Association, an organization formed in 1898 to foster and safeguard the commercial interests of the citizens of the United States, and others associated therewith, in Asia and the East. Membership 280.

American as Official Designation. In June 1904 an order was issued by Secretary of State Hay that on all new record-books, seals, etc., used by representatives of the United States in foreign countries there should appear the words "American Embassy," "American Legation," etc., in place of "Embassy of the United States," "Legation of the United States," etc., previously employed. The usage thus applied to all diplomatic establishments and consular officers had been followed by Secretary Hay when

ambassador to England, his position being that all countries composed of "United States," for example, Mexico, Brazil, Colombia, etc., were described by the geographical, not the political name of the country.

American Association for the Advancement of Science, a society originally known as the Association of American Geologists, founded at Philadelphia in 1840. In 1842 it added Naturalists to its name and was known by this title until 1847, when the present organization was formed. During the past 50 years the names of practically all the leaders of American science have been on the register of the association, and the 52 volumes of its 'Proceedings' contain many of the most important contributions to scientific literature published in this country. The association numbers about 4,000 (1903) members, including in its list of active Fellows such well-known scientific men as Newcomb, Barker, Brush, Young, Lesley, Morse, Langley, Mendenhall, Goodale, Prescott, A. Hall, Harkness, Morley, Gibbs, Gill, Putnam, Gilbert, Woodward, and Minot. Among prominent educators who are members and have taken active interest in its work are ex-President Gilman and President Remsen of Johns Hopkins, ex-President Low of Columbia, President Schurman of Cornell, President Jordan of Stanford, President Drown of Lehigh, President Pritchett of the Massachusetts Institute of Technology, ex-President Mendenhall of Worcester Polytechnic Institute, and President Dabney of the University of Tennessee. Many names prominent in the professions and in business are found on the list of members. The yearly meetings, held in different centres, occupy a full week, and as the work is now so extensive, the different sections hold separate meetings. The 'Proceedings' are published in an annual volume, and members receive the publication 'Science.'

American Association of China, a branch of the American Asiatic Association, organized in 1898 and located in Shanghai. Membership 100; office of the secretary, Shanghai, China.

American Baptist Missionary Union, The, a missionary organization of the Baptist Church, formed in Philadelphia 18 May 1814 as "The General Missionary Convention of the Baptist Denomination in the United States for Foreign Missions." The Southern Baptists withdrew in 1845 because of differences on the slavery question, and the society assumed its present name in 1846. The headquarters were established at Boston in 1826. The sole object of the Union is the diffusion of the gospel by means of missions throughout the world. Any church which has made a contribution to the Union during the year may appoint one annual member, and one annual member for every $50 contributed above the first $50, provided that no church be entitled to more than 10 annual members. Anyone may become an annual member on payment of $10 during the preceding financial year. At every annual meeting the Union elects a president, two vice-presidents, a recording secretary, and one third of a board of managers. The board of managers consists of 75 persons, at least one third of whom shall not be ministers of the gospel. The board of managers elects an executive committee, with chairman, recording secretary, corresponding secretaries, assistant secretary, treasurer, and auditing committee. For the year ending 31 March 1902 the Union had 481 missionaries and 3,325 native helpers. Receipts were $680,518.79, appropriations $621,853.71.

American Bar Association, a society organized in 1878, with a present (1903) membership of about 1,800.

American Bible Society, The, organized in New York in 1816, to encourage the wider circulation of the Bible. Its officers are a president and 26 vice presidents. The 88th annual report for 1903 shows that the society printed and purchased in the course of the year 2,058,989 Bibles, of which 1,993,358 were issued in foreign countries. The statistician of the society also states in the report that since its organization the society has issued more than 72,000,000 Bibles. The total number of Bibles issued in the United States in the year ended 31 March 1903, was 746,423, of which New York received 225,735, Pennsylvania 135,938, and Illinois 62,878. Wyoming received only 56 copies, and Arizona 87, while the Philippine Islands stand charged with 11,774 copies. Among the "sales and grants" to foreign lands it is interesting to note that Cuba received 20,398, Africa 6,725, China 1,425 and Canada only 218.

American Board of Commissioners for Foreign Missions, The, a missionary organization of the Congregational Church, formed at Bradford, Mass., 29 June 1810, "for the purpose of devising ways and means and adopting and prosecuting measures for promoting the spread of the gospel in heathen lands." Nine commissioners were then chosen, five from Massachusetts and four from Connecticut. A charter was not obtained from the Massachusetts legislature until 20 June 1812. The first annual meeting was held at Farmington, Conn., 5 Sept. 1810. At the close of its ninth decade (1891–1900) the Board had 20 missions, 97 stations, 1,209 out-stations, 167 ordained missionaries, and a total of 544 American laborers. Native helpers numbered in all 3,483. There were 505 churches with 50,892 members, and 120 high schools and colleges. For the nine decades 2,347 missionaries had been sent out, the aggregate receipts were $32,845,372.49, and 157,658 members were received into the churches in care of the Board. The Board is a corporate body, limited to 350 active members, selected by ballot, at least one third being clergymen and one third laymen. Honorary members (who become such on payment of $100, or, if clergymen, $50) may participate in all the deliberations of the Board, but do not vote.

American Bureau of Mines, an organization incorporated under the laws of the State of New York, with headquarters in New York city. The objects of the association are to reform and encourage the mineral industry of the United States; to discountenance popular error as to the financial and industrial conditions of mineral interests; and to effect mutually beneficial relations between capitalists and men of practical science. Facts bearing upon economic and statistical science which demonstrate the importance and general utility of these branches of knowledge are stored; trustworthy informa-

tion as to sound mining and other mineral enterprises is supplied, while such as are unsubstantial or spurious are exposed; and the services of an organized and permanent faculty of experts are provided. A Museum of Metallurgy and Practical Geology for the illustration of ores and mineral products, and of mining and metallurgical constructions and appliances, and a library and reading-room have been and are important sections of the organization's equipment.

American Bureau of Shipping, a maritime association established in New York in 1867, for the purpose of collecting and disseminating information upon subjects of marine or commercial interest, of encouraging and advancing worthy and well-qualified commanders and other officers of vessels in the American merchant service, and of promoting the security of life and property on the seas.

American Chemical Society, an association established in 1876 for the support and encouragement of chemical research. Membership about 2,200.

American Civic Association, an organization formed 10 June 1904 by the consolidation of the American League for Civic Improvement and the American Park and Outdoor Association, its objects being the cultivation of higher ideals of civic life and beauty in America, the promotion of city, town, and neighborhood improvements, the preservation and development of landscape, and the advancement of outdoor art.

The Association marks a distinct epoch in American development. Stockbridge and Newton Center, two Massachusetts towns, both of which have town improvement associations more than half a century old, lay claim to the first organized effort in the United States for the preservation of natural beauties and the general improvement of the village surroundings, but the movement which the association represents first began to assume large proportions in southwestern Ohio, where a number of manufacturers, publishers, and real estate men awoke to a realization of the fact that improved surroundings made better workmen, caused men to buy homes, and led people to become interested in good literature. The beginnings of the movement were along modest lines. The term "back yard improvers," first applied to its promoters in derision, was accepted as a watchword, and the progress made has been such that now the Association represents men who have undertaken all kinds of effort for public beauty and improvement, no matter how extensive. For some years there were two bodies working in this field — The American Park and Outdoor Art Association and the American League for Civic Improvement. A consolidation was effected at a joint meeting in Saint Louis in June 1904, and the result of this merger — The American Civic Association — represents about 480 local improvement organizations. The work of the Association is divided into the following various departments: Women's Outdoor Art League; Parks; Arts and Crafts; Children's Gardens; City-making; Outdoor Art; Factory Betterment; Libraries; Public Nuisances; Public Recreation; Railroad Improvement; School Extension; Social Settlements; and the Press. An active propaganda is carried on by means of department leaflets, clipping sheets, and other methods. Membership consists of life members, sustaining members, members, and affiliated members. The head offices of the Association are in Philadelphia, Pa.

American Climatological Association, a medical organization founded in New York city in 1884 "for the study of Climatology, Hydrology, and Diseases of the Circulatory and Respiratory Organs." Candidates for membership must have contributed something to the literature of the subjects before election, this insuring a select membership, which the roll shows to be very generally distributed among the medical profession throughout the United States, with distinguished honorary and corresponding members in England, Canada, Mexico, South America, South Africa, and Australia and other parts of the world. Annual meetings have been held since the foundation, at which papers confined strictly to the objects mentioned in the constitution of the organization are read and discussed and afterward published in the 'Transactions' of the Association; 20 volumes have already appeared, and copies are sent annually to the principal libraries throughout the world. The title of some recent contributions showing the value and wide scope of this association are: 'The Advantages of Southern California in the Treatment of Tuberculosis'; 'The Climate and Waters of Hot Springs, Va.'; 'Something of the Geography of Croupous Pneumonia'; 'Recent American Contributions to the Methods of Prevention and Treatment of Pulmonary Tuberculosis'; 'Climatology as a Study in the Medical Schools'; 'The Climate of Santa Barbara, California'; 'The Climatology of Muskoka, Ontario, Canada'; 'The Climates and Diseases of Central America and Panama.' The head offices are in Philadelphia; the organization must not be confounded with a similar important and co-friendly society, "The National Association for the Study and Prevention of Tuberculosis," with headquarters in New York city.

American College. See College, The American.

American College of Heraldry and Genealogical Registry, an institution similar in character to the British "Herald's College," founded in 1860 and incorporated under the laws of the State of New York. Its objects are to gather genealogies, or family records and family history, for perpetuation to posterity; the genealogical department recording births, marriages, and deaths; the historical, obtaining the derivation and compiling the history of families; and the heraldic, ascertaining, emblazoning, depicting, and engraving family coats-of-arms, crests, mottoes, etc. See Heraldry.

American College in Rome, Italy. This pontifical college was founded 8 Dec. 1859 by Pope Pius IX. for the purpose of training young men for the Catholic priesthood in the United States of America. By a pontifical decree it was placed under the direction of the Congregation of the Propaganda, the students being obliged to attend the courses of lectures given at the University of the Propaganda. The regular course embraces two years of philosophy

and four years of theology, while preparatory classes are held for students who have not completed the college course in their own country. The American College opened with twelve students, three of whom afterward became archbishops: Michael Corrigan, of New York; Patrick Riordan, of San Francisco; and Robert Seton, titular of Heliopolis. Ruben Parsons, the historian, was also one of the original twelve. The College has trained many distinguished churchmen during its existence of less than 50 years, giving to the United States 17 bishops, among whom are the present Archbishops Farley, of New York, and Moeller, of Cincinnati. It has likewise supplied the Catholic University at Washington with its present rector, Rt. Rev. Mgr. O'Connell, and with several professors; and two of the recently appointed bishops to the Philippine Islands, Denis Dougherty, of Philadelphia, and Frederick Rooker, of Albany, are among its alumni. The College has at present about 100 students.

REV. EUGENE DONNELLY,
Graduate of the American College, Rome.

American Commerce. The growth of a nation largely depends upon the development of its economic resources, and the success of the commercial and industrial institutions is to a great extent determined by the wisdom of the laws under which they operate, as enacted by the national legislative body.

In the early days of American commerce, the domestic industries did not aggregate in value many millions of dollars, and included mainly the manufacture of textiles, lumber, furniture, wagons, harness, hats, ships, meat products, and a few others of minor importance. Against this in 1900 may be placed the following statistics: Manufacturing establishments, 640,056; capital, $9,858,205,501; proprietors and firm members, 708,623; wage-earners, average, 5,370,814; yearly wages, $2,323,055,634; miscellaneous expenses, $1,030,110,125; cost of materials used, $7,363,132,083; and value of yearly product, $13,058,562,917. In addition, farm lands and products were valued at $20,439,901,164 and $4,739,118,752, respectively; minerals and their resultants produced in 1902 were valued at $1,260,000,000; the exports in 1903 were valued at $1,420,141,679, and the imports aggregated $1,025,719,227. In 1903 the merchant marine registered 24,425 vessels of 6,087,345 tons, including canal boats and barges; there being registered 12,836 sailing vessels of 1,965,924 tons, exclusive of canal boats and barges, and 8,054 steam vessels of 3,418,088 tons. In the coasting trade the tonnage of vessels registered was 5,141,0:7, and in the foreign trade and whale fisheries, 888,776 tons. In 1904 the total mileage of railroads was 212,349, representing liabilities of $14,289,259,959 and cost of road and equipment of $11,233,311,285. During the year 715,654,951 passengers were carried and 1,275,321,607 tons of freight moved. The total traffic and other earnings were $1,998,343,310. In 1903 the national debt amounted to $925,011,637, after deducting the treasury cash balance; the government receipts ordinary were $596,396,674, and expenditures, $477,542,658; post-office receipts, $134,224,443. In 1904 the money in circulation amounted to $2,519,142,860; the bank deposits were about $10,000,000,000; the bank clearings were $102,150,313,931; and the estimated wealth of the country was over $125,000,000,000.

For details see ALASKA, COMMERCIAL; AMERICA, UNITED STATES OF; AMERICAN MANUFACTURES; AMERICAN RAILROADS; AMERICAN MERCHANT MARINE; AMERICAN MINES; BANKS AND BANKING; COMMERCE; COMMERCE, INTERSTATE; COMMERCIAL ORGANIZATIONS; EXPORTS AND IMPORTS; EXPORTS AND IMPORTS OF THE LATIN-AMERICAN COUNTRIES; FINANCE; FOREIGN TRADE; INDUSTRIAL CORPORATIONS; PHILIPPINE ISLANDS, PRODUCTS OF; TRUSTS; UNITED STATES — FOREIGN COMMERCE OF THE; INDUSTRIES OF THE; HISTORY OF THE TARIFF; RECIPROCITY; COMMERCIAL DEVELOPMENT; ECONOMIC DEVELOPMENT; and the articles on the various industries in this encyclopedia.

American Commonwealth, The, an important study of American political, social, and economic conditions by James Bryce, the eminent historian of the Holy Roman Empire. Part I. treats of the Federal government. Part II. considers the State governments (including rural and city governments), their departments, constitutions, merits, and defects. Part III. is devoted to the political machinery and the party system. Part IV. discusses public opinion,— its nature and tendencies. Part V. gives concrete illustrations of the matters in the foregoing chapters. Part VI. is concerned with non-political institutions. The work is lucidly written and as easy for the laity to comprehend as for those familiar with the practical workings of our government. The chapters dealing with the professional and social sides of American life, and especially those devoted to the American universities, have been enthusiastically received by Americans.

American Conflict, The, an account of the American Civil War and its causes, by Horace Greeley. It is a great magazine of materials for the political history of the United States with regard to slavery.

American Cousin, Our, a well-known play by the English dramatist, Tom Taylor (1858). It was very popular in the sixties, and it was while present at its representation in Ford's Theatre in Washington that President Lincoln was assassinated.

American Dialect Society, an association organized in 1888 for the study of words in American English differing in pronunciation and use from the accepted usage. Membership 300. A bulletin of 'Dialect Notes' is published yearly. Office of the secretary, Western Reserve University, Cleveland, Ohio.

American Diplomacy. It may be justly claimed that the United States, in its brief existence as a nation, has exercised a greater influence in the same period in molding international law than any other nation; and it has done much to raise the standard of diplomatic practice. From the beginning it has stood as the champion of a freer commerce, of respect for neutral and private property in war, and of the most elevated ideas of national rights and justice.

When the United States entered the family of nations, there existed a marked contrast between the state of law which controlled the rights and intercourse of nations and that which enforced the rights and duties of the individual

inhabitants of the respective nations. The civil law, which was in force in most of the countries of continental Europe and their colonies, was the accepted product of the ripened experience of many centuries of Roman jurisprudence. The common law which prevailed in England and its colonies had been brought into an established system through the careful study and practical application of successive generations of renowned jurists. But the law of nations was then in its infancy. Only one century had passed since Grotius, who has been styled the father of international law, had compiled his treatise on the 'Rights of War and Peace'; and Vattel had but recently published his 'Law of Nations,' and the principles he enumerated were far from being an accepted code. International law was still in a formative state when the United States began its career. The latter had scarcely entered upon its organized life when the wars consequent upon the French Revolution forced it to consider its rights and duties as a neutral power. It soon learned that there were no established principles which warring nations respected. In referring to its early history, a secretary of state in 1853 said to the British minister for foreign affairs: "From the breaking out of the wars of the French Revolution to the year 1812, the United States knew the law of nations only as the victim of its systematic violation by the great maritime powers of Europe."

The first effort on its part toward the maintenance of international rules of conduct was in President Washington's neutrality proclamation of 1793, which, within less than a generation, brought about a complete change on this important subject. The proclamation was a simple announcement of the neutral attitude of the government, and a warning to American citizens to observe it. But the significance of the act was in the strict impartiality of its enforcement, and the resulting legislation of Congress, which became a model for all other nations.

The power of the President to issue such a proclamation based solely upon the principles of international law, without any domestic legislation respecting offenses against neutrality, was seriously questioned, and in 1794 an act was passed defining what were offenses against neutrality and affixing penalties therefor. During the revolt of the Spanish-American colonies so much trouble was occasioned thereby to the United States authorities that the law was carefully revised in 1818, and it has since practically remained unaltered. Hall, one of the latest English authorities on international law, says: "The policy of the United States in 1793 constitutes an epoch in the development of the usages of neutrality. . . . It represented by far the most advanced existing opinions as to what the obligations [of neutrality] were. . . . In the main it is identical with the standard of conduct which is now adopted by the community of nations."

The American colonies, in assuming their independence, established a diplomatic service similar to that of the European countries and it has continued to be so maintained. But the question has often been raised in and out of Congress whether, in the existing conditions of the world, the system is necessary and its utility justifies its expense. With many in the country the diplomatic service is regarded as a purely ornamental branch of the government and its maintenance a useless expenditure of public money. But whenever the question has been made the subject of inquiry by Congress, the various Presidents and secretaries of state have given their opinions in favor of the utility and necessity of the service, and Congress has continued to authorize it; and it has come to be accepted as a permanent branch of the government.

While the United States has adopted the European system of a diplomatic and consular service, in one important particular the general practice of other nations has not been followed. The service is not made a life career, and no examination is required for admission to it, either as consul, secretary of legation, minister, or ambassador. Appointments are made of persons usually from civil life, and without any previous diplomatic experience. The two systems have their advantages. It does not necessarily follow that because a young man can pass a successful examination, he is destined to make an able minister or ambassador. The British and other governments have frequently found it necessary to appoint to the highest posts in the diplomatic service persons from other branches of the administration or from civil life. On the other hand, the system followed by the United States exposes the government to mistakes and sometimes to mortification and ridicule because of the inexperience or inaptness of its representatives. But appointments to the higher posts are generally of persons who have served and gained distinction in legislative bodies or in the professions, and although not experienced in the arts of diplomacy, they are usually able to cope with their colleagues on all subjects where great principles are involved. There is a growing sentiment, however, in the country in favor of at least placing the consular service upon a permanent basis.

Up to recent years the highest grade in the diplomatic service of the United States has been that of minister plenipotentiary, but these representatives sometimes complained that they were often humiliated and their usefulness sometimes impaired by the lower positions to which they were assigned in the diplomatic corps. The remedy suggested was to raise the rank to that of ambassador. Secretary Marcy declined to make the recommendation to Congress in 1856. A similar position was taken by Secretary Frelinghuysen in 1884, who said it would be an injustice to the ministers to give them higher rank without increasing their salaries, and that Congress would not vote the allowance commensurate with the mode of life of an ambassador. Later Secretary Bayard claimed that serious inconveniences would arise from introducing "into our simple social democracy . . . an extraordinarily foreign privileged class."

Notwithstanding these objections, in 1893 Congress authorized the appointments of ambassadors to countries whose governments would reciprocate in such grade, and ambassadors are now sent by the United States to London, Paris, Berlin, St. Petersburg, Vienna, Rome, and Mexico. Soon after the reception of ambassadors in Washington the question was raised whether they should have precedence over

the Vice-President, but it has been decided against them. The "inconveniences" anticipated by Secretary Bayard have been experienced on more than one occasion, but the innovation seems to be permanently established.

The fiction of international law that ambassadors represent the person of their sovereign in a greater degree than ministers was created at an epoch when there was a recognized distinction between empires and monarchies, and between these two grades and republics. All distinction between sovereign nations has been abolished, and they now stand on an equality, but the ambassadorial pre-eminence is still recognized, even in the American democracies.

The diplomatic dress or uniform of an American representative, although an apparently trivial matter, has occasioned considerable discussion and a varied action on the part of the government. In the early years of its history, the diplomatic representative was left without any instruction upon the subject, but when the commissioners to negotiate peace with Great Britain in 1814 went to Europe a simple uniform was adopted, and by a circular of the department of state in 1817 this uniform was prescribed for the diplomatic representatives at foreign courts. This order continued in force, with some modification during the administration of Jackson, up to the advent of Secretary Marcy, who prided himself on his attachment to republican simplicity. In 1853 he issued a circular which became famous in diplomatic annals, in which the representatives of the United States were advised to appear on public occasions "in the simple dress of an American citizen" unless such costume was objected to by the court to which the representative was accredited. The circular was much criticised, but its spirit was practically approved by Congress in the passage of an act in 1867 prohibiting officials in the diplomatic service from wearing any uniform or official costume not previously authorized by Congress. As by law only officers who have served in the army or navy are authorized to wear a uniform in the diplomatic service, the great body of the corps come under this prohibition.

From the time of Dr. Franklin, the first minister to France, American diplomatic representatives have sought to be distinguished by entire frankness and straightforward conduct. This is indicated in the instruction to John Jay when he was sent abroad on an important mission by President Washington. The secretary of state wrote: "It is the President's wish that the characteristics of an American minister should be marked on the one hand by a firmness against improper compliances, and on the other by sincerity, candor, and prudence, and by a horror of finesse and chicanery."

Much is said in disparagement of the American diplomatic representatives abroad, and it is not to be disguised that under the system of appointments some unfit and uncultured persons have been found in the service who have reflected little credit on the country. But their discreditable acts have been out-done by the misconduct of the representatives of foreign governments accredited to Washington. This misconduct has embraced flagrant violations of international law and practice, intermeddling with domestic politics, and official and social improprieties of various kinds. Within the first century after the organization of the government, a list has been created of foreign diplomats dismissed by the government of the United States, or recalled in disgrace, which embraces three British ministers, two French, two Spanish, one Russian, and one Austrian minister. No such record of dishonor can be compiled against American representatives as that made at the seat of government of the United States by the representatives of the most polished nations of the Old World.

The War of 1812, undertaken by the United States against Great Britain, was pre-eminently a struggle on the part of the former to maintain and enforce correct principles of international law. It involved the claim by Great Britain of the right of visitation of neutral vessels and the impressment of such of their crews as the visiting party saw fit; the doctrine that free ships make free goods, or the exemption of innocent neutral commerce from seizure in time of war; and the paper blockades which were sought to be enforced by the warring powers. None of these questions were settled by the terms of the treaty of peace between the United States and Great Britain. But the contention of the United States as to all of them has come to be accepted by all the nations of the world, and by none of them more heartily than by Great Britain. The right of visitation and search of vessels was a frequent subject of negotiations, but while the British government relaxed the enforcement of its alleged right after the war, its claim was not finally abandoned until 1858, when it formally accepted the contention of the United States. A strange incident in connection with this question occurred soon after that date. During the Civil War, the commander of a United States naval vessel arrested a British mail steamer, the Trent, on the high sea, visited her with an armed force, and carried away as prisoners two Confederate diplomatic agents en route to Europe. In the United States the naval commander was hailed as a hero, but in England the act was regarded as an insult to the British flag and a just cause of war. A hostile conflict was avoided by the prompt surrender of the Confederate agents and a disavowal of the act, as in direct contradiction to the attitude of the government consistently maintained from its foundation of the immunity of the vessel carrying the American flag.

The claim of the right of impressment (q.v.) was connected with the subject of naturalization and expatriation, which has been the occasion of much diplomatic correspondence and controversy on the part of the United States with European powers. From the beginning of its existence, the former has encouraged immigration; liberal laws for the naturalization of foreigners have been passed; and the right of expatriation has been maintained. In this branch of international law this attitude has had a marked effect upon the practice of nations. One of the chief causes of the War of 1812, it has been seen, was because of the impressment of seamen, naturalized citizens of British birth, taken from American vessels. The old common law doctrine was that no British subject could denationalize himself, and that he owed perpetual allegiance to the crown; but the persistent claim of the United States was finally recognized by Parliament in the nat-

uralization act of 1870. The doctrine of expatriation is now generally accepted by the nations, and the United States has succeeded in having it embodied in many of its treaties.

The subject of free ships was given much prominence through the armed neutrality during the Revolutionary War, was one of the unsettled issues of the War of 1812, and was finally recognized as a principle to be incorporated into the international code by the great powers of Europe, as embodied in the Declaration at Paris of 1856. This declaration consisted of four rules, which were, briefly stated, (1) the abolition of privateering; (2) the exemption from seizure of an enemy's goods under a neutral flag; (3) a like exemption of neutral goods under an enemy's flag; and (4) that a blockade, in order to be valid, must be effective. All of these but the first had been long advocated by the United States, and even the first had been incorporated in its treaty with Prussia of 1785. The latter was plainly in the interest of nations having a strong navy. Nevertheless, the United States was ready to accept them all as rules for the government of nations, but Secretary Marcy proposed to the great powers that they go one step further and declare that private property of belligerents at sea be exempt from capture. As private property of belligerents on land has been exempted by the rules of war, there would seem to be no sufficient reason why the same treatment should not be applied to like property at sea. President McKinley instructed the American representatives at The Hague Conference of 1899 to advocate it, but they were not successful. President Roosevelt continued to urge upon the nations this advanced measure to mitigate the ravages of war, but it has not yet been inserted in the international code.

The fourth rule of the Paris Declaration was, in effect, a formal recognition of one of the principles contended for in the War of 1812, that there can be no blockade by mere proclamation. Its application bore heavily upon the United States during the Civil War, but it consistently observed the principle by making its blockade of the southern ports effective. An effort has been made of late years to establish what is known as a pacific blockade, by which one or more States seek to bring constraint upon another State by closing its ports without a declaration of war. In the case of the blockade of Crete by the great powers of Europe in 1897, the United States declined to concede the right as applicable to its commerce; and when a similar attempt was made in 1902 of a pacific blockade of Venezuelan ports by Great Britain, Germany, and Italy, the objection of the United States to its interference with American vessels led to the abandonment of the project, and to the establishment of a real war blockade.

The subject of neutrality assumed an important phase during the War of the Rebellion, and the duties and responsibilities of a neutral state were the occasion of a heated controversy with the British government. Although the latter had incorporated in its laws the substantial provisions of the United States statutes of 1818, it dissented from the position asserted by the United States as to its duties in the practical application of its acts of Parliament and the recognized principles of international law. The construction of Confederate cruisers in British ports and the aid afforded them in such ports was held to be a failure on the part of that government to discharge its duties as a neutral power, and for these acts the United States made grave complaint and filed a large claim for pecuniary damages. After much discussion the matter was submitted to the arbitration of a tribunal, which met at Geneva. (See GENEVA TRIBUNAL.) In the treaty providing for the arbitration there were inserted three rules as to neutrality which were to govern the arbitrators in their decision. These rules were based upon the American statute and mainly followed the contention of the United States. The result was a decision in favor of the latter, with a large award in damages. The two governments had agreed in the treaty that they would submit the rules to the other maritime powers for their acceptance, but this was never done, chiefly because of the extreme construction placed upon some of their clauses in the opinions of the neutral arbitrators. The general consensus of publicists is that these rules are a correct statement of existing international law.

One of the conspicuous features of the relations of the United States with foreign nations is its readiness to accept arbitration for the settlement of questions that do not prove susceptible of adjustment by diplomatic methods. It has been one of the foremost of the nations in advocating this method of arranging international complications, and in preserving peace by means of treaties of arbitration. The first treaty negotiated after the organization of the government under the Constitution — the Jay Treaty (q.v.) of 1794 — was made with Great Britain to avert war which was then imminent. It contained provisions for the adjustment of three of the most irritating of the questions in controversy by a reference to arbitration, and three separate commissions were created for that purpose. The year following, the second treaty negotiated by the new government, that with Spain of 1795, also contained a provision for arbitration. The country was not so fortunate in its second controversy with Great Britain. The questions at issue were of such grave character that it did not seem possible at that day to settle them by any other method than a resort to war; but by the treaty of peace of 1814 four boards of arbitration were created to settle boundary questions. These all related to the frontier with Canada, which ever since the independence had been a source of almost constant discussion, often of angry controversy, and more than once has brought the countries to the brink of war. But in every instance when the usual method of diplomacy failed, arbitration has been resorted to with success.

During the two generations which followed the War of 1812 all questions of controversy with foreign powers, with one exception, have been settled by peaceful methods. In that period the United States created many courts and commissions of arbitration. The most of these have been with Great Britain, but more than 20 of them have been with other nations of Europe and America. The controversy growing out of the manner in which the British government enforced the neutrality laws during the Civil War, for a time threatened the peaceful relations of the two countries. When the offer of

the United States to adjust the question by arbitration was made, the British government in the first instance assumed the position that its national honor was involved, and that that could not be submitted to arbitration. But better counsels prevailed, and the Tribunal of Geneva was created to adjust the controversy. It was the most important arbitration in which the United States ever engaged, and was one of the most august and imposing ever held in the world. It involved questions of supreme importance and pecuniary claims of great magnitude; but its special significance was in the spectacle of two great nations being able to compose weighty matters, which had awakened the passions of their people to a high state of bitterness, by an appeal to reason and the arbitrament of friendly powers in place of war.

Next in importance for the United States to the Geneva arbitration was that relating to the protection of fur seals in Bering Sea, held in Paris in 1893. The decision of the tribunal was against the contention of the United States, and as a result it had to pay about half a million of dollars in damages and sustained a heavy loss in its annual income from the seal islands. Disappointment was felt over the result, but the mature judgment of the country is that it was a wiser settlement of the questions at issue than to push them to the extreme of war.

One feature of the many arbitrations in which the country has engaged is worthy of special notice. A spirit of equity and fair dealing has always marked the conduct of the government in cases where any suspicion of fraud or exaggerated damages has attached to arbitral decisions. The commissions with Venezuela, Haiti, Mexico, and other countries might be cited in illustration. They show that, though the government is sometimes misled by designing claimants or by the unwise action of its diplomatic agents, it has not hesitated when fully possessed of the facts to undo any injuries inflicted upon friendly powers by means of international commissions, and that fraud, once exposed, cannot reap the benefit of its iniquity under the cover of the finality of an award.

The Alaskan Boundary Tribunal of 1903 is an instance of the settlement of a question not possible of adjustment by diplomacy and not deemed appropriate for reference to arbitration. A court was constituted, composed of three members from each country, and they were empowered to judicially settle the questions submitted to them. The danger feared was that there would be an equal division of the court, but in this case the matter was settled by an award rendered by a majority of the members which has been accepted by both governments.

This brief review shows that in its short career the United States has had an important part in molding the code of international law. The chief actors in the work done by this country have been the secretaries of state and its diplomatic representatives abroad. But they have had worthy coadjutors in giving this code shape and permanence. The exposition of the law of nations, as set forth in the decisions of the Supreme Court of the United States, has had a great influence in molding that law, and its opinions are recognized as of the highest authority by foreign publicists. Among authors in this department of law none carry greater weight throughout the world than Story, Kent, Wheaton, Halleck, Woolsey, Wharton, and other American writers. When the services are recalled of these diplomatic, judicial, and scholastic representatives of the United States, it is just to say that no body of men in any country have done as much to improve and enlarge the principles of international law, or have exercised a more salutary influence on the affairs of the globe. See also DIPLOMACY; INTERNATIONAL LAW; UNITED STATES — THE DIPLOMACY OF.

JOHN W. FOSTER.

American Economic Association, a society organized in 1885 for promoting free discussion of economic questions and the publication of monographs. Membership 1,000. Office of the secretary, Ithaca, N. Y.

American Electro-Therapeutic Association, a society formed in 1892 for the promotion of knowledge in whatever relates to the application of electricity in medicine and surgery. Membership 200. Office of the secretary, New Haven, Conn.

American Embargo. See EMBARGO.

American Entomological Society, an association established in 1859 for scientific investigation of insect life. Membership 125. Office of the secretary, Philadelphia, Pa.

American Farm Implements. The production of food and fibre absorbs about three fourths of the labor of the male workers of the world. In the United States, during the early decades of the 19th century, about 80 per cent of the male workers of the nation were employed on the farm. During the past century, however, farm implements and machines have come into use which have so increased the efficiency of labor that about 35 per cent of the male workers of the United States produce the food and fibre of the nation, and furnish an enormous surplus which is exported to other countries. Nowhere else in the history of human industry can so striking an illustration be found of the influence of inventions upon the welfare of mankind. From time immemorial, until the 19th century, agriculture was carried on by hand labor. Horses or oxen were used for plowing and harrowing, but the labor of seeding, planting, cultivating and harvesting the crops was performed by the exertion of human muscle. Wheat was sown broadcast by hand, reaped by hand with a sickle, and separated from the straw and chaff by hand labor. Corn was planted by hand with a hoe, and cultivated with a hoe, and was gathered and shelled by hand. Grass was cut with a scythe and raked and handled with hand rakes and forks. Production was so limited by these primitive methods that people who wished, like the pioneers of America, to enjoy an abundance of food and other simple comforts of life, were compelled, of necessity, to live on the farm, where they could be assured, by their own efforts, of a proper supply. The farmer was unable to produce a surplus that would feed a large urban population. Manufacturing industries were not only limited by the lack of food to sustain cities, but were also limited by the lack of a market for factory products, for an agricultural country which could not produce a surplus for sale was unable to buy the products of urban industries.

The farmer of the North lived in a log cabin, wore homespun, and sent his children to a log schoolhouse. The only section where agriculture was conducted on a commercial basis was the South, where the planters profited by slave labor.

It is generally assumed that the railroads brought prosperity to the people, by affording the pioneer farmer the means to market his products. Government statistics throw an interesting light on this subject. Railroad construction in the United States began in 1828, and continued at the average rate of about 300 miles per year until 1846. For a few years the commerce of the country made substantial growth, but the period from 1837 to 1846 was one of great depression, which the railroads were unable to relieve. Bank resources, which showed but little loss in the year following the panic of 1837, shrunk to a remarkable degree from 1840 to 1843, the only period in the past seventy years when there was a serious loss in bank capital. The railroads did not stimulate the production of wheat during this period, for a large amount was imported from Europe in 1837, and the census reports show that the crop of 1839 amounted to only 4.97 bushels per capita, which was not enough to supply the people with wheaten bread. From 1800 to 1846 exports of flour amounted to an average of about a million barrels per year, and showed no material increase, while exports of wheat were actually less from 1830 to 1840 than in the first decade of the century.

If the first 15 years of the railroad be compared with the first 15 years of the reaper, a most remarkable contrast is found. The reaper was first placed on the market successfully for the harvest of 1845. In 1847 exports of wheat and flour leaped to $32,178,161, about five times the average of the preceding forty years, and grew rapidly from 1850 to 1860. The wheat crop, which had not increased as rapidly as population from 1839 to 1849, gained more than 70 per cent from 1849 to 1859, the largest increase that is shown in any census decade. In 1880, after 35 years of the reaper, exports of wheat and flour amounted, in one year, to $225,879,502. Prior to 1850 corn was used extensively for bread, because the supply of wheat was deficient, but since 1850 the United States has produced for exportation a surplus of about five billions of bushels of wheat. Railroad construction, which had averaged only 300 miles per year prior to the introduction of the reaper, made remarkable gains in 1847 and 1849, and progressed at the rate of about 2,000 miles per year from 1850 to 1860.

A broad examination of the subject shows that railroad construction and agricultural inventions have gone hand in hand in the development of agriculture in America. Railroads could not be operated profitably in the agricultural States without the traffic that is produced for them by labor-saving inventions on the farm; and, on the other hand, there would be little demand for these inventions if the railroads were not available to market large commercial crops. The farmer of a century ago, without these inventions and the railroads, was a peasant who toiled with his hands to produce a living for his family. The farmer of to-day is a machine operator who rides on a comfortable spring seat and uses labor-saving inventions to produce commercial crops. American inventions have made agriculture a commercial business in which a man, without employing help, can support a family comfortably and produce wealth. American farmers enjoy a greater average of comfort and wealth than any other class of people, of equal numbers, in the world.

The reaper, invented in 1831 by Cyrus H. McCormick (q.v.), of Rockbridge County, Va., and patented by him in 1834, was the first important step in developing the implements and machines of modern agriculture. Wheat must be harvested within a few days after it ripens, or the crop will be damaged or destroyed by the weather. When wheat was cut with sickles a man could only harvest three to five acres, in an average season, and this limitation accounts for the small production of wheat prior to the introduction of the reaper, which broadened production by enabling a given number of men to harvest a larger acreage. The McCormick reaper of 1831 was used successfully for several seasons, but the facilities for manufacturing a complex machine like a reaper were so limited at that time that it was not until 1845 that the invention was made a commercial success. The McCormick reaper embodied the foundation principles of modern harvesting machines. The machine was balanced on two wheels, like a cart, one, the master wheel, being geared to furnish power for the mechanism. The platform extended between the two wheels, and on its front edge was the cutting mechanism, a reciprocating knife, operated by a crank, and moving over fixed fingers. The most notable feature of the McCormick reaper was the divider and the revolving reel, which separated the grain to be cut from the standing grain, and laid the flowing swath, by a positive delivery, on the platform, so that the straws would lie in parallel order and make a compact sheaf when bound. It was the reel and the divider that made the McCormick invention a commercial success, because grain in all the ordinary conditions of harvest could be handled successfully. The greatest problem in reaping is not to cut the grain, but to make it lie down peaceably on the platform after it is cut, especially since a large proportion of the wheat crop becomes more or less lodged and blown down by winds and rains before it is cut. A score or more of inventors had anticipated McCormick in efforts to design or construct reapers, but while some of them had machines that would cut the grain, they had no practical devices for delivering it in gavels so it could be bound into sheaves. Robert McCormick, the father of Cyrus H., made a machine in 1816 with a revolving scythe, and in the papers of Thomas Jefferson is found a copy of a letter which he wrote to an inventor, commenting on the design of a machine of the same character. None of these numerous designs of American and English inventors proved practical, and it remained for Cyrus H. McCormick, who inherited the problem from his father, to bring together the four essential elements of modern harvesters: the reel, the divider, the reciprocating knife and the platform. A few years after the reaper was made a commercial success, the self-raking attachment took the place of the man who had raked off the gavels by hand. In 1858 C. W. and W. W. Marsh, of Illinois, patented a notable improvement which

THE OLD WAY OF CUTTING AND BINDING GRAIN.

THE NEW WAY—THE GIANT REAPING AND BINDING MACHINE.

led the way to the modern binder. In their machine endless toothed belts carried the grain from the platform over the master wheel, and deposited it in a receptacle. Two men stood on a footboard or platform outside the master wheel, and, taking gavels alternately from the receptacle, bound the sheaves on tables attached to the machine. In 1873 the first automatic sheaf binding harvester, the invention of Sylvanus D. Locke, was placed on the market, and a year or two later other machines of the same type, using wire to bind the sheaves, were successfully introduced. About the time the wire binder had become settled on the market, a new invention, the twine binding mechanism, upset all the calculations of harvesting machine manufacturers, as the farmers preferred twine to wire, which became scattered over the fields from the threshed straw and proved a nuisance. The foundation patents on the twine binding mechanism were issued in 1875 to Marquis L. Gorham, of Rockford, Ill. After he had tested his invention in the field, but before he had perfected it for the market, death cut short his career, and it remained for John F. Appleby, of Beloit, Wis., to complete the development of the twine binder. More than twenty manufacturers took licenses under the Gorham and Appleby patents, and twine binders were placed on the market in 1880, since which time the business has grown to large proportions. Fully a million binders are in use on American farms, and a large export business has grown up. Through the use of American harvesting machines, Russia, the Argentine and Australia have become large exporters of wheat, and single cargoes of American machines, which are shipped to European countries, contain more machines than the entire output of any European manufacturer in this line.

In any humid climate it is necessary to bind the wheat in sheaves and let the straw and grain dry out in the shock before threshing, but in many of the western States the harvest season is dry, so that a more economical method can be followed. In western Kansas and Nebraska, and other States farther west, headers are used successfully. The header is a wide cut machine, usually taking twice as wide a swath as a binder, and cutting just below the heads, which are elevated into a wagon and hauled to stacks or ricks to await the thresher. In California, Oregon and Washington the combined harvester carries a threshing attachment, which is operated by the traction wheel, so that a wide swath is cut and threshed and delivered in bags as the machine is drawn across the field by horses or a traction engine. The combined harvester, however, can only be used where the harvest season is very dry, and where the straw grows stiff, so that the wheat can stand until it is dry enough to thresh.

The mowing machine, the corn planter and the two-horse corn cultivator, distinctively American inventions, have served the same purpose in promoting the production of meat in the United States as the reaper in promoting wheat growing. Farmers were not able to produce live stock and dairy products on a large commercial scale until they had been provided with labor-saving inventions for the cheap production of hay and corn. Obed Hussey was the inventor of the foundation features of the mowing machine, but his work was not completed until the hinged or floating bar had been invented by Lewis Miller. Hussey's first patent was taken out in 1833 on a reaper which he had made near Cincinnati, Ohio, that year. Owing to the fact that he obtained his patent on an improvement in reaping machines, and the further fact that it was issued a few months before the first McCormick patent on the reaper, many writers have given to Hussey the credit for the invention of the reaper. The two machines, however, were essentially different. The Hussey machine had no reel or divider, and while the cutting mechanism worked well, it was never a commercial success as a reaper, because it could only be used when the wheat stood up straight. The McCormick reaper was balanced on two wheels, like all modern harvesters. The Hussey machine had four wheels, two in the same position as the wheels of a modern mower, and besides these a grain wheel, at the grainward end of the platform, and a castor wheel at the rear. Dropping the two superfluous wheels and the platform, the machine embodied the foundation features of a mower. In 1847 Hussey patented, as an improvement on his machine, the open back guard or finger, which proved a vital feature of successful mowing machines. The upper part of the finger, through which the knife moved, was cut away at the rear, so that grass and trash which were drawn into the slot by the knife were swept away to the rear by the pressure of the grass passing over the bar. Curiously enough, Hussey never made any serious effort to develop his machine as a mower. He believed all his life that he was the inventor of the reaper, and for twenty-five years he worked incessantly but unsuccessfully to establish his machine on the market as a reaper. The only financial reward that he ever reaped, however, was in 1858, near the close of his life, when a syndicate of mowing machine manufacturers, who were operating under license from him, paid him $200,000 for his patents. A few years before, he had made application to the Court of Claims at Washington for a financial reward from Congress for his inventions, stating that he was not worth at that time more than $500 above his liabilities. He worked all his life, the greater part of the time in poverty, in efforts to establish his invention as a reaper, and did not know that his patents covered the foundation features of the mower, a machine second only to the reaper in its importance to agriculture. It remained for practical licensees under his patents to recognize their value and pay him for them a price far in excess of the reward that he had hoped to obtain from Congress. In 1856 and 1858 the most important patents on the hinged or floating bar were issued to Lewis Miller, of Canton, Ohio, who was identified with the leading firm in the syndicate that bought the Hussey patents. Miller's improvement allowed the bar to float freely over the ground, and to rise or fall at either end so as to conform with the inequalities of the surface.

While the mower was the most important hay-making invention, because it enabled the farmer to harvest a larger acreage of hay, many other inventions have been of vast service in promoting the cheap production of forage. Steel sulky rakes made short work of gathering the hay into windrows, and the hay tedder, which is used after the mower to shake up the hay so it

will dry quickly, makes it possible to put the hay in the barn or stack within a few hours after it is cut. Hay loaders are now used extensively, taking the hay from the swath or windrow and loading it on the wagon. Barns are equipped with hay carriers and forks, operated by a horse, which take the hay from the wagon and save the hard labor of pitching it by hand. The same equipment is also used for stacking in the field. On western ranches, very wide sweep rakes are used to gather the hay and drag it up to the stack, where a stacker, operated by a horse, elevates it from the ground to the stack.

Next to harvesting machines, the threshing machine is undoubtedly the most important feature of the mechanical equipment of modern agriculture. Early in the 19th century the "ground hog" thresher came into use. This was a simple machine, operated by a tread power, threshing with a spiked cylinder which revolved over a spiked concave. It had no mechanism for cleaning the grain. The straw was forked or raked away from the tail of the machine by hand, and the pile of chaff and grain was afterwards cleaned by running it through a hand fanning mill. These machines, however, found but little use so long as the crop was limited to the amount that a man could reap with a sickle, as the farmer could store his small crop in the barn and thresh it out in winter, either with horses on the barn floor, or with the flail, a long, jointed club. The first English separator, combining a threshing cylinder with fanning and screening devices, was made in 1800, but this was a stationary machine, like many other inventions of that period, designed to be set up in a mill, to which the grain must be brought. Hiram A. and John A. Pitts, of Winthrop, Maine, were the inventors of the first portable threshing machine with cleaning devices. They were engaged in making horse powers for operating "ground hog" threshers, and in 1837 they patented a machine which combined the threshing cylinder with an endless belt and beaters, which separated the grain from the straw and chaff. George Westinghouse (q.v.), the father of the inventor of the air brake, began making threshing machines at Fonda, N. Y., about 1840, later removing to Schenectady, and he patented a number of practical improvements in separating and cleaning devices. After 1850, when farmers began to raise wheat for market, a large number of inventors and manufacturers of threshing machines entered the field, and machines of the endless apron or grain belt type soon came into general use. Soon after the Civil War, however, these machines gave way to the "vibrator" type of separator. The endless apron or grain belt, in spite of all the beaters and shaking attachments that were used with it, allowed a little grain to go through with the straw and be wasted. Cyrus Roberts, of Belleville, Ill., patented in 1852 and 1856 the chief features of the modern separating mechanism, which consists of a series of vibrating rakes over which the straw passes from the cylinder. The most notable improvement of recent years is the "wind stacker." The tail of the machine is closed, and the straw is blown by a revolving fan through a large steel pipe. This invention saves the labor of all the men who were formerly needed on the straw stack. Automatic band cutting and feeding attachments, and automatic grain weighers, have also come into general use. The horse power was succeeded in the decade following the Civil War by the portable engine, and this in turn by the traction engine, which, for countries where coal is scarce, is fitted to burn straw.

The grain drill was one of the latest of modern implements to come into general use, as the farmers found it more economical, until well past the middle of the century, to sow their wheat broadcast by hand. English inventors began patenting grain drills in the 18th century, and many American patents were issued prior to 1850, but the grain drill did not become a practical implement until it was provided with a force feed, which would regulate exactly the amount sown. The first patent on a practical force feed was issued in 1851 to Foster, Jessup & Brown, of Palmyra, N. Y.; but it was not until farmers began sowing commercial fertilizers that drills replaced broadcast seeding in the East. In the West, the "hoe" or pointed tube of the early types of grain drills could not be used successfully in prairie soil, and the farmers sowed their grain by hand, or used simple broadcast seeders, until the drill manufacturers had borrowed the shoe from the corn planter. In late years disc drills have become popular.

The first patent on a practical corn planter was issued in 1853 to George W. Brown, of Illinois. This implement was not, as many writers have supposed, an adaptation of the grain drill. The function of the grain drill is to spread the seed as much as possible, so the crop will cover the ground and prevent the growth of weeds. Corn, however, does not thrive unless each hill has at least a square yard of clear, cultivated soil around it, and hence corn is planted in hills, and the hills are placed in check, so they can be cultivated both ways. The Brown invention planted two rows. It was operated by two men, or a man and a boy, one of whom drove while the other sat in front and operated the dropping lever. It was customary, before the introduction of the check rower, to mark the field by driving across it with a sled which had two or more runners, making marks at the proper distance apart for the hills. The planter was then driven at right angles across the marks, and the operator of the dropping lever would aim to drop the hills even with the marks, so they would be in alignment across the field, as well as in the rows following the planter. The check rower, which was invented and introduced by George D. Haworth, of Illinois, as an improvement on the planter, operated the dropping mechanism automatically. A wire is stretched across the field, anchored at each end, and as the planter is driven forward the wire draws through it, and buttons or links at suitable intervals operate the dropping device. The Haworths were the practical inventors of this device, and placed it on the market, but did not obtain a clear patent on it, as, technically, it had been anticipated by a prior inventor, whose patent was assigned to them and reissued. The most ingenious and original feature of the George W. Brown patents on the corn planter was the planting shoe, which was shaped like a scimeter, so it would cut through or rise over any trash on the surface of the field. The seed dropped through a channel in the heel of the shoe, and was covered by a wheel which followed.

A MODERN STEAM PLOW THAT TURNS SEVEN FURROWS AT ONE TIME.

So many inventors have contributed useful features to the two-horse straddle-row cultivator that it would be difficult to name any one who is entitled to pre-eminent credit. Cultivators are made in a greater variety of forms and styles than any other implement in extensive use, but the basic idea of all modern cultivators is to utilize two horses and straddle the row. Two wheels, with an arched axle, support the frame work and the seat for the operator. The cultivating shovels or points are attached to two gangs or frames, one on each side of the row, which swing freely and are held in the proper position by the operator, by means of stirrups in which he holds his feet. Walking wheeled cultivators are still used to some extent, but the prevailing demand is for riding implements.

Harvesting the corn crop is a problem that has engaged the attention of American inventors since 1850, but it was not until 1895 that a practical corn binder was placed on the market. This machine was patented in 1892 by A. S. Peck, of Illinois, but did not prove practical until many improvements had been made by inventors of the McCormick experimental staff. A binding attachment, much like the mechanism of a grain binder, stands in a vertical position in the machine, and the corn is carried into it by gathering chains while the machine travels forward astride the row. A later type of this machine is the corn shocker, which holds the corn erect in a frame, without binding it in bundles, until a shock is collected, when the frame and shock are raised by a crane on the machine and swung around to the ground, the shock, meantime, being tied at the top by the operator. The latest successful type of machine for harvesting corn is the corn picker, which travels along the row in the field and picks and husks the ears without cutting the stalks. The portable corn husker and fodder shredder, which is operated like a threshing machine, has also proved a successful invention, and many thousands of machines of this type are now in use, especially in the dairy States, where the farmers want to save the fodder and shred it for feeding. Power corn shellers have been in use since 1860, and are indispensable wherever corn is grown for shipment to market. The first successful machine of this type was invented by Augustus Adams, of Sandwich, Ill.

For the preparation of the soil a multitude of implements are used. The subject of Plows has been considered in a separate article. Harrows are made in many forms, including the disc harrow, which is used extensively in place of the plow, to prepare stubble land for seeding. The steel disc has made its appearance in grain drills, and in planters, and has even endeavored to supplant the moldboard in the plow. Potato planters, spraying implements and digging machines have placed the potato crop on a commercial basis. Cotton planters are used successfully, but disappointment has been the only reward of inventors who have sought to devise a cotton harvester. The greatest service which the inventor could render to the cotton grower was the invention of the cotton gin by Eli Whitney (q.v.). While the gin is not strictly speaking a farm implement, since it is not used on the farm, it made a great commercial crop of an obscure plant that had been of little or no value to the farmer. R. L. ARDREY,

Chicago, Ill.

American Federation of Labor, a national organization of American trade-unions, in which the rights of the constituent units are preserved intact. As in the Federal government, all powers not expressly granted in the written constitution are reserved to the subordinate bodies: but still further, as in the Articles of Confederation, it has not power of compulsion (except to suspend or expel a union), and any union can override its decisions as far as its own action goes. To this is due its steady growth and harmony. What every union fears most of all is being controlled in matters pertaining to its own trade by persons outside that trade; and a minority regularly coerced on its own ground will eventually secede.

It originated in 1881. Its predecessors had been the National Labor Union, 1866–72, which ended its career by entering politics and nominating a candidate (David Davis) for the Presidency; and a number of sectional orders, of which the chief was the Knights of Labor (1869). The latter were generally hostile to trade-unions, holding them based on "false and selfish principles of temporary advantage, to the sacrifice of the general interests" of labor, and the Knights attempted to break down trade barriers in workmen's action by organizing local assemblies of miscellaneous laborers. This antagonized those who believed that only members of a given craft had a right or the proper knowledge to direct its action; and on 2 Aug. 1881 representatives from trade-unions, the Amalgamated Labor Union (a split from the Knights of Labor) and the Knights of Industry, both secret orders, held a conference at Terre Haute, Ind., ostensibly to establish a national labor congress, but in reality (as stated) to form a new order to supplant the Knights of Labor. This was defeated, and the conference issued a call for a convention at Pittsburg in November, where the Federation of Organized Trades and Labor Unions of the United States and Canada was constituted. On 8 Dec. 1886 this fused with a separate trade-union congress, and changed its name to the American Federation of Labor; and in 1889 acknowledged the continuity of existence by dating its proceedings to 1881. Its membership is of local unions, central unions of cities, State federations, national and international trade-unions. As a local union may thus belong to three different superior bodies, with a possible conflict of jurisdictions, the Federation takes charge of these mutual relations. It recognized the national and international unions as having supreme jurisdiction, but it approves and urges State and central bodies as helpers in gaining the common objects.

These objects, as stated in its constitution, are: (1) "The encouragement and formation of local trade and labor unions, and the closer federation and combination of such bodies, to secure legislation in the interest of the working masses." (2) "The establishment of national and international trade-unions, based upon a strict recognition of the autonomy of each trade," etc. (3) "An American Federation of all national and international trade-unions, to aid and assist each other," and "the sale of union-label goods, and to secure national legislation in the

interest of the working people, and influence public opinion by peaceful and legal methods in favor of organized labor." (4) "To aid and encourage the labor press of America."

Its executive organization at first was a secretary and a legislative committee, and it announced that it would have no salaried officials; but for efficient working it has been compelled to modify this rule. It has a salaried president and secretary, a treasurer, and six vice-presidents, who together form the executive council, which meets quarterly. The president for many years has been Samuel Gompers.

The funds are derived from a per capita tax of 6 cents per year from each member of an affiliated trade-union, and $10 each from central unions and State federations. Until 1887 it could not grant money in aid of strikes; but in that year a revised constitution gave the executive council the right to call on the unions for financial aid to such strikes as it approved. This voluntary aid was insufficient, and in 1889 another amendment permitted it to levy a compulsory tax of 2 cents a week on each member of an affiliated union, for not over five weeks, in aid of strikes or lock-outs.

The policy of the Federation is fixed in open conventions held in a different city in November of each year. The affiliated organizations are entitled to but one delegate until their membership reaches 4,000, two delegates up to 8,000, three delegates up to 16,000, four delegates up to 32,000, and so on. Thus, for instance, the largest affiliated organization, the United Mine Workers of America — having a membership of fully 225,000 — will send seven delegates, and is entitled to no more.

The chief rival of the American Federation has been the Knights of Labor; but it has practically supplanted that from the superior rationality of its basis. The Knights admitted anyone to membership except lawyers, bankers and saloon-keepers; the Federation confines membership to workingmen, not admitting even farmers who are employers of labor on their farms. The Knights were a centralized society based on lodges established by the central union; the Federation is based on its unions' individuality. But chief of all, the Knights assumed that organizations of all classes of workers in one union in each locality would bring about the best results, while the Federation realized the organization of each trade in its particular union and the affiliation of all unions in a comprehensive federation was sure to strengthen each and bring advantage to all. The Knights confounded all distinctions and potentially overruled each trade by the vote of outsiders. By recognizing the common-sense principle that each interest can manage its own affairs best, the Federation has grown till, on 1 Oct. 1903, it had in affiliation national and international unions, 112; State federations, 29; central unions, 529; and local unions, 1,725. The total membership of unions is estimated at about 1,750,000, of whom more than half have joined since 1897. It does not contain all the trade-unions, a considerable section still remaining outside, as the great railroad federation of five unions, and the Bricklayers' Union; but it contains the United Mine Workers of America (its largest body), the International Typographical Union of North America, the Brotherhood of Carpenters and Joiners, the Cigar Makers' International Union, etc.

Its activity in securing favorable and defeating unfavorable legislation for laborers has been very great and very successful. These are too many to detail; but it may be said that its first convention of 1881 demanded a national eight-hour day for government employees, and exclusion of Chinese and contract laborers; and all these were granted by 1886. It also secured the establishment by law of Labor Day. Since then it has steadily favored shorter hours, non-employment of children, better sanitary conditions, regulation of convict employment, abolition of "government by injunction," etc.; and in 1893 pronounced decisively for free coinage. It began in 1894 the publication of 'The American Federationist,' an official monthly magazine. Consult: Aldrich, 'American Federation of Labor,' Vol. III. of Economic Studies (1898); Gompers, 'The Labor Movement'; McGuire, 'The American Federation of Labor'; and annual reports of the Federation. SAMUEL GOMPERS,

President American Federation of Labor.

American Folk-lore Society, an association founded in 1888 for the collection and publication of the folk-lore of North America. Membership 410. Office of the president, Field Columbian Museum, Chicago, Ill.

American Forestry Association, a society organized in 1882 and incorporated 1897. It aims to promote a business-like and conservative treatment of the forest resources of this continent; the advancement of educational, legislative, and other measures tending toward this end; the diffusion of knowledge regarding the conservation, management, and renewal of forests, the proper utilization of their products, methods of reforestation of waste lands, the planting of trees for ornament, and cognate subjects of arboriculture. Membership 2,000. Its official organ is 'Forestry and Irrigation.' Office of secretary, Washington, D. C.

American Geographical Society, an association established in 1852 and aiming to encourage geographical exploration and discovery; to investigate and disseminate new geographical information by discussion, lectures, and publications; to establish in the chief maritime city of the country, for the benefit of commerce, navigation, and the great industrial and material interests of the United States, a place where the means will be afforded of obtaining accurate information for public use of every part of the globe. It has a geographical library of 30,000 volumes and a large and very valuable collection of maps, charts, and atlases relating to every part of the world. It publishes a 'Bulletin,' and co-operates and interchanges information with 200 domestic and foreign geographical and other scientific societies. Membership 1,200. Office, 15 West 81st Street, New York.

American Historical Association, a society organized in 1884 and incorporated by an act of Congress in 1889 for the encouragement of historical research. Membership 1,100.

American Indians. See INDIANS, AMERICAN.

American Institute of Architects, an association organized in 1857 for the advancement of the art or profession of architecture. It has published its 'Proceedings' annually since 1867. Its permanent headquarters are in its own building, the "Octagon," Washington D. C. Membership 800.

PLOWING A FURROW SIX FEET WIDE WITH A TRACTION ENGINE.

American Institute of the City of New York, an organization founded in 1828 for the promotion, by exhibitions and fairs, of agricultural, commercial, manufacturing, and artistic interests throughout the Union. It is now divided into five sections: The Farmers' Club, the Henry Electrical Society, the Horticultural Section, the Photographic Section, and the Polytechnic Section. It has a scientific library of 15,000 volumes.

American Institute of Electrical Engineers, a society established in 1884 for the advancement of electrical engineering. It publishes volumes of its 'Transactions.' Membership 1,600.

American Institute of Homœopathy, a society organized in 1844. Membership 2,000.

American Institute of Mining Engineers, an organization founded in 1871 to promote the arts and sciences connected with the economical production of the useful minerals and metals, and the welfare of those employed in these industries, by means of meetings for social intercourse and the reading and discussion of professional papers, and to circulate, by means of publications among its members and associates, the information thus obtained. Membership 3,500.

American Ipecac. See GILLENIA.

American-Irish Historical Society, founded in Boston, Mass., 20 Jan. 1897, to make better known the Irish chapter in American history. The organization draws no creed lines and is non-political. It has published a number of books and pamphlets along its chosen line of work. The society is national in its scope, and has members throughout the country. The organization holds its annual gathering in New York city, and publishes yearly a bound volume called the 'Journal' of the society. The membership is about 1,000. In addition to the national officers, there is a vice-president for each State.

Americanisms, in language, are words or phrases peculiar to the English speech of the United States or of British America. They may be (1) forms originating in America; or (2) forms that have emigrated from Britain and that have continued in use here while they are obsolete there; or (3) that have undergone here an essential change of signification. Examples of words originating here or at least first introduced here into the vocabulary of the English language are Buncombe, Caucus, Gerrymander; of words here in current use but now antiquated in England we have Fall (the season), Wilt (verb), Whittle; and of words with changed signification we have Corn (maize), Partridge (quail or ruffed grouse), Store (in England shop). These three processes of new word coinage, of survival of meanings in one province of the language which in another province have become obsolete, and of essential change of signification, are inherent in all languages, and can be traced in a comparison of two counties as clearly as in two countries. Americanism expresses the character of English speech in America: it does not imply any inferiority of American English to British English; nor is American English subject to correction by the laws that British English prescribes for itself: Americanism and Briticism in speech are mutually on an equal footing; unlike Gallicisms, Germanisms, or even Scotticisms, Americanisms are not aliens in English, but natives. Among the Americanisms to to be noted in what follows are many words or phrases which belong to the vocabulary and phraseology of slang, and are universally regarded as vulgarisms and solecisms and vicious growths of the vernacular speech of America; as such they are "Americanisms," but they are no more part of legitimate American speech than is costermongers' English part of the English language of the home country.

In the front rank of Americanisms must be classed those which are most racy of the soil and that could not have been evolved in any social or physical environment other than was and is presented in this new world. The first settlers had to clear the boundless forest which covered the land, and constantly to guard their lives and their possessions against the forays of the savages: they went always armed to their day's work. Such words and phrases as Going on the war path, Digging up the hatchet, Burying the hatchet, Scalping, Tomahawking, recall the hero-tales of American pioneering; and from the same period come Shanty, Blazing out, Clearing, Backwoods (in Canada, "the Bush"). They "took to the woods" or "to the timber" for refuge at the approach of the redskins in overwhelming force. In the sparsely peopled settlements the necessity for neighborly help in gathering in the harvest or in erecting a log cabin or in providing comforts for the winter led to the custom of the Raising-bee or Building-bee, the Quilting-bee, the Husking-bee: the origin of the word Bee in this sense is unknown; the custom itself survives in rural districts, and a few years ago a new sort of Bee — the Spelling-bee had great vogue; and that was followed by the Definition-bee; these "bees" met with much popular favor in England. Logrolling is another example of co-operation among backwoodsmen, when neighbors associate to collect each other's logs for the winter fires. Logrolling came early into use as a term of the art of practical politics to signify the co-operation of members of a legislative body to promote one another's schemes. Literary Logrolling is when authors combine to create a market for each other's productions by mutual puffery. Salt springs to which the big game used to resort were Salt Licks; the spaces between stretches of water over which the pioneers had to carry their canoes were Portages. As settlers began to seek homes in the West on government lands, the distribution of the public domain became a business of vast proportions and "a Land-Office business" became a superlative term of comparison. A Section of land is a square mile or 640 acres; a very usual subdivision is the Quarter section, 160 acres. In the nearer West, as in the East, bodies of land were Farms; in the farther West, Ranches; in the South, Plantations. The verb to Deed is a pure Americanism: the phrase "To convey by deed" was too slow. A settler who acquired land from the government "blazed out" his grant by cutting with his axe marks on the bark of trees: the word is from the French *blason*, a term of heraldry. A Lot of ground is any distinct portion of land, and in towns and cities is a piece of ground with a definite frontage, usually 25 feet. The use of the word lot in the

sense of a parcel of land seems to have originated with the Puritans in Massachusetts: for this they had scriptural authority, Joshua xv. To go Across lots is to take the shortest route; but to make a Bee line toward a place is to haste to it in a straight line. Immigrant is an Americanism, and it is the accurately fit word to signify one who comes to a country as a settler. Tenderfoot, a most expressive American slang word to designate the newcomer into a newly opened gold or silver mining district, is current coin no less in Australia than in the Rocky Mountains. In California, in the early days, many words came into use and have since remained in general circulation, for example, Placer, Prospecting, Diggings, Pay Dirt, Gulch. Bonanza is of later introduction. Crevasse is a breach in the embankment of a river; the word is of French origin in the province of Louisiana and specially denotes the effect of a flood of the Mississippi River. Of like origin is the word used to designate the embankment of the Mississippi, Levee. The word is also used to designate a river front of towns situate on other rivers in the Mississippi valley which are naturally confined within their own banks. In English usage Levee is accented on the first syllable, but in the United States the accent falls usually on the last. Incidentally it may be remarked of another American usage of the word Levee to signify an evening reception of visitors by the President of the United States, "the President's Levee," that it is a rank solecism, and means in effect *a morning reception in the evening.* Freshet, in obsolete English usage, meant a stream of fresh water: in the sense of an inundation it is an Americanism. Blizzard, signifying a violent, blinding storm of wind, snow, and sleet, is a word of unascertained origin. Prairie is as distinctly American as Veldt is South African or as Tundra is Russian and Siberian.

In the vocabulary of politics, besides Logrolling, already mentioned, we have Gerrymander, to make an unfair distribution of electoral districts for party ends: this American political trick is called by the English political philosopher Jerrymandering; and one of the English dictionaries gives as an alternative spelling Jerrymander, while in Gerrymander it makes the g soft: thus pronounced, the word Gerrymander is a Briticism. What for the British is a political canvass is for us a Campaign, and a Campaign is conducted to a considerable extent in accordance with the tactics and strategy of real war. The successful party is the Victor, and to him, under the ancient laws of war, belongs the spoil. Speaking from the Stump, Taking the stump, were originally literal expressions of fact. Buncombe, or Bunkum, seems to be authentically derived from the name of a county of North Carolina, whose representative in Congress, when begged not to weary the House with his oratory, replied that though he was addressing the House he intended his speech for the good people of Buncombe. The derivation of the word Caucus from Calkers is plausible. In 1770 the calkers and ropemakers of Boston held frequent meetings to denounce the British government and its local agents, and those meetings were called by the Tories Calkers' meetings. The Caucus, a preliminary meeting held for the purpose of selecting a candidate for office, or, in case of a legislative body, to decide upon the policy to be supported by members of a party in the open sessions, is an American invention; of late it has been introduced in England. Spread-Eagle oratory has its name from the extravagant style of stump orators and Independence Day spouters when they glorify the Bird of Freedom. Highfalutin, a word that cannot be traced to its original source, denotes turgid, bombastic oratory. To Enthuse is unquestionably an Americanism, and it is base coin formed from the word enthusiasm, which, whether in Greek or English, has no corresponding active-transitive verb form. Of party names and nicknames may be mentioned Whig and Tory, of the pre-revolutionary era, Federal and Republican of the period after independence, then Whig again, and instead of Republican either Democratic Republican or simply Democrat, with the nickname (about 1835) Locofoco (given first to a body of radicals who, in Tammany Hall, New York, after a meeting was officially dissolved and the lights put out, produced locofoco matches, rekindled the lights and continued the meeting: the locofoco match, or locofoco cigar was introduced in 1834, the word meaning "substitute for fire"— *in loco foci.* It was a cigar with friction-match attached). Other party names and nicknames are Republican, Silver-grays, Copperhead, Carpet-baggers, Lily Whites. The man in any political organization who possesses or is believed to possess authority to dictate the party's policies is the Boss. The word is the Dutch *baas* and is the usual designation of an employer or overseer of workmen. A few years ago political terrorism in the South, designed to bar to negroes access to the polls, was known as Bulldozing, a word which cannot be traced to its origin with certainty, and which is no longer in use. Roorback is a false and injurious report set afloat in the crisis of a political campaign, usually a very short time before the canvass is closed, so that it may have damaging effect before contradiction or refutation can be made. The phrase "a good enough Morgan till after election" recalls an incident in the history of New York politics. William Morgan, author of a book purporting to reveal the secrets of Freemasonry, was kidnapped, and the anti-Masonry party charged the Freemasons with having murdered him. To counteract this charge, which was credited largely by public opinion, the Masonic society, or rather its friends in the Whig and Democratic parties, spread reports of the finding of the missing man; whether true or false, these reports furnished "a good enough Morgan till after election."

Right, as equivalent to very, is by some writers classed among Americanisms; but that is an error, though undoubtedly the word is more commonly used in that way here than among the English. In the style Right Reverend, Right Worshipful, etc., Right has the meaning of very: in Tyndale's Bible occur such phrases as Right sorry, Right humble, and in writers of the 14th century the same usage is to be seen. But Right here, Right now, Right away, Right off are Americanisms and are not found in the colloquial speech of Britain. In British English of these latter days Sickness is hardly used save in the sense of nausea; but the best British authors do not countenance that restriction of meaning. In the United States, outside the circles in which the time o' day is

given from London, the words Sick and Sickness have the same signification they have had in the general language at least from the 14th century, when mind-sick, mind-sickness, were current phrases; and in the King James version of the Bible sick and sickness have the same purport which they have in the American vernacular. Ugly, in the sense of cross-grained, ill-natured, is an Americanism, though English usage has the nearly parallel phrase, an ugly customer. An American can ride in a coach; but an Englishman, if he is to ride at all, must go on horseback or be borne on the back of some other animal. British restriction of the meaning of Ride is inconsistent with the usage of the translators of the Bible, who make Joseph, for example, and Jehonadab ride in chariots. The garment which Americans style Vest is better styled by the English Waistcoat. Peart, pronounced, and often written, Peert, meaning lively, brisk, sprightly, without any suggestion of sauciness or "freshness," is gone out of use, at least of literary use, in England: it is an Americanism, but its habitat, so to speak, is restricted. A special use of Peart is to signify the improved tone of one who is recovering from a sickness.

The place of business at retail which in England is a Shop is in the United States a Store. Of late a tendency has appeared toward adoption of the British usage of these terms. In regions unaffected by this tendency Shop is still what it was 50 years ago in this country, a work-place, and a Store is a place where goods are kept in store for sale. But even while Shop and Store retained their cis-atlantic meanings, there were numerous phrases current which are inconsistent with the American meanings of Store and Shop, for example, Shop-worn, Smelling of the shop, Shop-boy, Shopping, Shopkeeper, Shop-lifter, etc. The grocer's store or shop is here called a Grocery, not so in England: there Grocery signifies only the wares sold by a grocer. Unquestionably American is the use of the word Drummer in the sense of one who solicits or touts for custom. The phrase, He struck oil, will probably survive after all the oil wells have gone hopelessly dry.

What we call Baggage is by the British called luggage, though the reason of the difference can hardly be that we travel with less impedimenta than they. The development of our railway systems has brought many new words into the vernacular, but none more expressive than the verb Telescope.

The conversational speech of Americans at one time seemed to be seriously threatened with invasion by a host of spurious, illegitimate word-coinages, especially of verbs made out of nouns, as to Advantage, to Ambition, and of pompous verbs made out of nouns ending mostly in *-ation*, as Orate, Donate; but that danger was happily averted. The use of Transpire in the sense of happen, occur, is of American origin, but the use quickly spread to England: the solecism was promptly branded by scholars, but it still lives and flourishes. Balance, in the sense of remainder, is another Americanism which has attained a currency which it does not deserve. Mad, in the sense of angry, is an Americanism of the baser sort. To Wilt, on the other hand, a "provincialism" in England, but in America a word in universal use, is one of the valuable contributions of the American province of the English language to the mother tongue's general store. The proverbial Whittling of the Yankee keeps alive an ancient native English word for knife.

Among notable or curious phrases current in the United States may be mentioned Flying off the handle,— losing self-control through passion: one is then like the axe-head which has quit the haft. To Get religion, or even to Take religion, is a phrase constructed on the pattern of "to take a cold" or "to take the measles." To be Posted plainly had its origin in the counting-room.

Bibliography.— Pickering, 'Vocabulary of Words and Phrases Suffered to be Peculiar to America' (1816); Lowell, introduction to 'The Biglow Papers' (1848); Elwyn, 'Glossary of Supposed Americanisms' (1858); Bartlett, 'Dictionary of Americanisms' (1859); White, 'Words and their Uses,' chap. 3 (1870); Schele de Vere, 'Americanisms' (1872); Harris, 'Uncle Remus' (1880); Farmer, 'Americanisms, Old and New: a Dictionary of Words, Phrases, and Colloquialisms Peculiar to the United States, British America and the West Indies' (1889); Norton, 'Political Americanisms' (1890); Emerson, 'Dialect of Ithaca' (1891).

JOSEPH FITZGERALD,
Author of 'Word and Phrase.'

Americanists (from *Americanistes*), all those who devote themselves to the study of (1) the native races of America — their origin, distribution, history, physical characteristics, languages, inventions, customs, and religions; (2) the history of the early contact between America and the Old World. The name was probably first given to the members of the French Société Americaine de France, and later to students of any nationality who are interested in the archæology, ethnology, and early history of the two Americas. Since 1875 such students have met at irregular intervals in an association known as the Congrès International des Americanistes. This congress grew out of the Société Americaine de France, which was formed in 1857 by several French students who had become interested in the pre-Columbian civilizations of South America and Mexico; after this society had flourished for 18 years its members decided to invite Americanists of foreign countries to a congress. The first international meeting was held in 1875 at Nancy, France, where statutes were adopted and plans laid for the continuance of the organization. Since then ten other meetings have been held in various European cities, and two in America (City of Mexico, 1895, and New York city, 1902). At first the intention was to hold biennial sessions, but after a few years it was decided to meet at irregular intervals, the council of each congress determining the time and place of the next session. The meetings have a polyglot character, as speakers may use either French, German, Italian, Spanish, or English. The addresses may be either written or oral, and are limited to 20 minutes in length. All papers presented may, with the approval of the committee, be issued in the printed 'Proceedings' which are usually in French ('Congrès International des Americanistes, Comte-Rendu'), and published in two volumes for each meeting. In addition to the papers the reports contain

lists of the members enrolled and minutes of the business transacted at each session. Any one interested in the subjects discussed may become a member of any congress by a subscription (three dollars, American money, or an equivalent in the currency of the country where the congress meets), which entitles him not only to take part in the sessions but to receive the reports of the congress and all other publications issued by it. The subjects considered at each meeting range through meteorology, geology, archæology, and ethnology to comparative philology, the history of the pre-Columbian arts and religions, the early discoverers of America and its early relations to European nations. Representatives from almost every nation, even from China and Japan, are found on the lists, which have included as members (not necessarily as attendants) many of the most eminent archæologists, ethnologists, and anthropologists in Europe, England, and America. For a full account of the 13th congress, held at the American Museum of Natural History in New York city 20–25 Oct. 1902, see 'Science,' New Series, Vol. XVI. p. 884. Previous meetings are reported in 'Nature,' Vol. XIV. p. 355; 'Popular Science Monthly,' Vol. XXXIV. p. 686; and Vol. XXXVIII. p. 685.

American Jewish Historical Society, an association organized in 1892 for the purpose of collecting and publishing material bearing on the history of America. It is a national organization with a membership of 243. President, Dr. Cyrus Adler; secretary, Max J. Kohler.

American Labor. According to the census of 1900, the total number of people in the United States engaged in gainful occupations of all kinds was 29,074,117, of which number 23,754,205 were males and 5,319,912 females. These figures include wage-earners and wage-payers, employers and employees, engaged in manual and professional service. Of this number between 18,500,000 and 20,000,000 may be reckoned wage-earners. And although statistics are lacking, we will not be far astray if we estimate that the corresponding classes at the beginning of the national existence numbered about 500,000.

As to the racial composition of this class, four fifths of the population of the United States at the close of the Revolutionary War was of English descent, but at the present time careful consideration would indicate that only about one half of our population can claim the English as their mother tongue; and yet, during the first quarter of the 19th century, immigration could not have affected the nationality of our working people to any great extent, nor until 1840. In 1833 the largest number in the first third of the present century arrived, being 58,640 immigrants. Great impetus was given in the forties by the famine in Ireland in 1846–7, and by political causes in Germany. The total immigration since the Revolutionary War and up to July 1901, was 20,253,073, while the foreign-born residing in this country at the census of 1900 was 10,460,085, being 13.6 per cent of the whole population. These large additions to our population had a marked influence upon our industrial conditions, because in the very nature of the case their numbers, almost *en masse*, went to swelling the ranks of labor. The manufacturing and mechanical industries absorbed a much larger proportion of the new element than agriculture, and the tendency of our immigrants to assimilate with our mechanical industries increases the supply of labor in comparison to the demand, and at times may have lowered wages and crippled the consuming power of the whole body of the population. But this was not serious, and it may have been imperceptible, for at the time of the accelerated movement of immigration there was a vast development of the railroad interests of the country, which could not have been carried on so extensively and completely without a large body of common laborers. Immigration supplied this labor, but it soon began to find its way into organized industry. As the tendency of wages has been constantly upward since the close of the 18th century, it cannot be argued that the assimilation of immigrants with our own native labor has reduced wages, but it can be assumed that such assimilation may have retarded their increase beyond what was experienced. During the years of depression after 1893 immigration was checked, but with the renewal of prosperity during the past few years the movement has practically assumed its old proportions of nearly half a million a year. The character of immigration has changed, and this change has not been for the better. If immigration could be left entirely to natural motives it is quite evident that the movement would be retarded gradually, but it is stimulated by transportation companies, in their desire to secure business, to such an extent that a large body of objectionable immigrants are brought here. When it is known that an immigrant can be transported from Italy to Chicago for less money than a first-class passenger can travel from New York to Chicago, it is not strange that people flock to the United States; and during this past decade it is quite certain that labor in America has suffered through this class of immigration, especially in mining districts, where wages have been kept down and much distress has prevailed through the influx of cheap foreign labor.

At the nation's beginning its labor was domestic, and working people were engaged in agricultural pursuits, the fisheries, and in the clearing of forests, while a small percentage were engaged in what is known as domestic manufacture and in commerce. The factory system, dating from 1790 as the year of its birth, did not become influential until after 1820. With the complete establishment of textile factories, in 1813, at Waltham, Mass., where the first complete factory in the world for the manufacture of finished cloth was built, labor began to find a new avenue of employment, and the young women of the rural districts were induced to enter factories as spinners and weavers. Thereafter growth of the textile factory was rapid, both in New England and the Middle States. Fair wages and easy work attracted the women of our own country, and English girls, until Irish immigration commenced, and during the last 25 years or more the Irish operative has been giving way gradually to the French-Canadian and representatives of other nationalities.

Of course, all manufacturing received a great impetus during the Revolutionary War, when our people were obliged to furnish their own supplies. At the close of the war these efforts ceased or production was greatly reduced, and

America was still a subject of Great Britain in respect to its manufacturing interests, until the complete establishment of the factory system. The old domestic or hand system was not long in passing, and the régime of invention and machinery holds full sway. Along with this change in the method of production, mining has been developed to an enormous degree, until now the United States produces more iron than Great Britain. This industry has brought into employment a vast body of skilled workmen, and the ramifications of the industry still greater forces. Our large towns and cities are, as a rule, thoroughly equipped with sewers, and the manufacture of pipes and mains for this purpose, as well as the manufacture of gas-pipes and mains and plumbing work generally, has been the result. These latter changes have occurred within the last 60 years.

be seen from the accompanying table. This change was largely brought about by the factory system, under which women could attend light-running machines with skill and with fair remuneration. They constitute a new economic factor in industry, and being a new economic factor, they cannot as yet hope to receive liberal wages. It can hardly be said that they have displaced men, but they have displaced boys and girls to a considerable extent. The first tendency under the factory system was to employ children, and the number constantly employed increased from year to year until the last 25 years, when the number has been rapidly on the decline. Public sentiment voiced by legislation, as well as the economies of production, is driving the children out of our factories; women are taking their places. In some industries men have taken the places of women, the change of the form of work result-

NUMBER OF MALE AND FEMALE WAGE-EARNERS REPORTED FOR PRINCIPAL OCCUPATIONS IN 1900.

Occupations	Males	Females	Total
Agriculture, Fisheries, and Mining:			
Agricultural laborers....	3,747,668	663,209	4,410,877
Fishermen and oystermen	67,715	462	68,177
Lumbermen and raftsmen	71,920	100	72,120
Miners and quarrymen..	562,501	1,365	563,866
Stock-raisers, herders and drovers	83,056	1,932	84,988
Domestic and Personal Service:			
Barbers and hair-dressers	125,542	5,574	131,116
Bartenders	83,377	440	88,817
Engineers and firemen (not locomotive).....	223,318	177	223,495
Housekeepers and stewards	8,224	146,929	155,153
Laborers (not specified)	2,505,287	123,975	2,629,262
Launderers and laundresses	335,282	50,683	385,965
Nurses and midwives...	12,265	108,691	120,956
Servants and waiters...	276,958	1,283,763	1,454,791
Watchmen, policemen, and detectives........	129,711	879	130,590
Trade and Transportation:			
Agents (claim, commission, real estate, insurance, etc.) and collectors	230,606	10,556	241,162
Bookkeepers and accountants	180,727	74,153	254,880
Clerks and copyists....	544,881	85,246	630,127
Draymen, hackmen, teamsters, etc........	538,029	904	538,933
Hostlers	64,850	79	64,929
Messengers and errand and office boys.......	64,959	6,663	71,662
Sailors and boatmen....	78,253	153	78,406
Salesmen and saleswomen	461,909	149,230	611,139
Steam-railroad employees	580,462	1,688	582,150
Street railway employees	68,873	46	68,919
Stenographers and typewriters	26,246	86,118	112,364
Telegraph and telephone operators	52,459	22,556	75,015
Manufacturing and Mechanical Industries:			
Bakers	74,860	4,328	79,188
Blacksmiths	226,284	193	226,477
Boot and shoe makers and repairers	169,393	39,519	208,912
Butchers	113,578	378	113,956
Carpenters and joiners..	599,707	545	600,252
Cotton-mill operatives...	125,788	120,216	246,004
Dressmakers	2,090	344,794	346,884
Iron and steel workers..	287,241	3,370	290,611
Machinists	282,574	571	283,145
Marble and stone cutters	54,317	143	54,460
Masons (brick and stone)	160,638	167	160,805
Milliners	1,739	86,120	87,859
Painters, glaziers, and varnishers	275,782	1,759	277,541
Plumbers and gas and steam fitters..........	97,659	126	97,785
Printers, lithographers, and pressmen.........	139,166	15,981	155,147
Saw and planing mill employees	161,251	373	161,623
Seamstresses	4,837	146,105	150,942
Silk-mill operatives.....	22,023	32,437	54,460
Tailors and tailoresses..	160,714	68,935	229,649
Textile mill operatives (not otherwise specified)	53,437	51,182	104,619
Tin-plate and tinware-makers	68,730	1,775	70,505
Tobacco and cigar factory operatives	87,955	43,497	131,452
Wood-workers (not otherwise specified)......	104,468	6,805	111,273
Woolen-mill operatives..	42,566	30,630	73,196

The change in the system of work has practically done away with apprenticeships, their place being more than filled by manual training and the work of the trade schools. With the establishment of the factory system apprenticeships were less obligatory. By 1850 the resort to them was waning, while since the vast development of the factory system, especially subsequent to the Civil War, they have been still less prevalent. Another great change which has come in the way of industry is the employment of women, who were engaged only in domestic labor, except in rare instances, in 1789, but are now represented in almost all industries, as may ing in such displacement. Laundry work is practically factory work now; and the old domestic hand weavers, who were to a large extent women, have seen their work transferred to the factory. These industrial revolutions have carried with them other changes, which perhaps are more ethical than economical in their relations. For instance, under the old system of labor, employers had a paternal relation to their employees, and even in the early cotton-mills in New England the paternal system of caring for employees was adopted, notably at Lowell, and later on also in Manchester, Conn., under the Cheneys' administration of the silk works; but

as the factory system has spread, this paternal care has been lessened, although during the last few years there has been a great revival in the discussion of the usefulness of such paternal oversight. The public is considering this question, and great employers here and there are trying the experiment of taking an interest in the home welfare of their employees as well as in their efficiency.

The changes in the industrial system have had many ramifications. The labor movement in this country began with the 19th century. Prior to the establishment of the factory system there was little organization. Here and there a club of skilled workingmen existed, notably in the Eastern and Middle States. Since 1825, however, the movement has been rapid, and its results, while not always satisfactory, are indicative of real progress. In the early years of the labor movement many arguments were advanced against it, and the attempt made to prevent workingmen from joining in organization. The merchants and ship owners of Boston, at a meeting held in the Exchange Coffee Rooms on 15 May 1832, voted to discountenance and check what was called the unlawful combination formed to control the freedom of individuals as to the hours of labor, and to thwart and embarrass those by whom they were employed and liberally paid. It was held everywhere that labor ought to be left free to regulate itself, and that neither the employee nor the employer should have the power to control the other; and the stock argument that organization would drive trade from the country was resorted to. But the condition of labor as it now exists is a vast improvement upon its condition at any other period. It may, perhaps, be well simply to say that wages, even during the past half-century, have increased, on the whole, something over 60 per cent, while the general course of prices has been downward, and to such an extent that the relative real wages — that is, wages measured by wholesale prices, and showing, on this basis, the purchasing power of money — have increased over 90 per cent since 1860. To-day organized labor has many defenders. It is looked upon with disfavor in some quarters, but as a rule, employers are quite willing that their employees should organize, for they have their own organizations and do not feel like denying the right to others. Of course, a very large proportion of the working people of this country is unorganized, and I presume this is true of manufacturers and employers on their side; but as the methods of production are brought to a larger and grander scale, organization in every direction will more and more prevail. At present organized labor is estimated at 2,000,000. This is the result of an estimate based on the claims of different organizations. I am inclined to think it is too liberal an estimate, and yet, placed in comparison with 18,500,000 wage-earners, it does not seem large; but, as a rule, organized labor is employed in the manufacturing and mechanical industries, and in this sense the percentage is high. The proportion of organized manufacturers to the whole body is probably much larger. As the labor movement has grown, strikes have become more frequent, and while undoubtedly the era of strikes is passing away, yet it will be some time before the downward scale is reached as to numbers and importance. The great strikes in the country have had a marked influence in many directions. They have excited working people to undertake other strikes; they have brought bitterness between employer and employee, and yet on the whole they are bringing a new line of thought to the public mind, and their study will result in good to all classes. Strikes are teaching the public its interests in industry as over against the personal and selfish interests of the two parties immediately involved.

The labor question has met with a great change as a result of the Civil War. Our negro population has lost some of the old occupations in which it was engaged in the North half a century ago, but it is gaining others. In the South the employment of the negro is becoming more varied and his condition more hopeful as one of pecuniary prosperity. Negro labor is abundant, good, and steady in certain lines. The question is often asked, whether the division of employment lessens the quality of work. Probably not, for the great principles of modern industry are association, concentration, and specialization. With the first the second is absolutely essential, and the third is the result of concentration. If these things lessen the quality of the work, then the opposite must be true — that without them quality is improved. This carries the argument too far. If there is much truth in it, then the simplest, humblest kind of work is best for the worker, and sawing wood and paving streets, the most ordinary manual toil, would be better for the worker than the employment of his intellect in tending a machine.

Working people have experimented with co-operation, profit-sharing schemes, and other methods of increasing wages. These experiments have met with varying success. They are likely to do some good, but it will be a long time before the moral character of the men involved will permit successful management of co-operative schemes. The co-operative principle is that of our modern system of industry. Pure co-operation, probably, cannot succeed, from an economic point of view, but the co-operative spirit can prevail to a higher degree than it now does; and these things have reduced the hours of labor from 11, 12, and 13 per day to 8, 9, and 10 per day. These changes, however, came gradually, and as the result of improved methods of production. Then law stepped in and made the custom the public voice. The first ten-hour law in this country, however, was not passed until 1874, when the State of Massachusetts provided that women and children should not be employed over ten hours a day in the textile factories of the State. Another specific change which has come is the frequent payment of employees for their services. The method in former times was to pay the working people part in cash and part in goods, and settlements were made at long intervals. Now everywhere, with a few exceptions in the West, where to some extent the truck system still prevails, cash payments at short intervals are the rule. This change has been brought about both by public sentiment and by statutory enactments.

One of the greatest changes which has been wrought by the new system has come through corporations. When the century began, the workingman and his employer were practically associated. With the establishment of the fac-

tory system there came the necessity of using large capital, more than one man or a firm of men contributing; so the corporation became a necessary factor in the development of industry. The ethical relations between employer and employee were changed at once. In this way the organization of labor has grown on the ground that one organization should deal with another; that if the stockholders lose their personality and are represented by a manager, the large body of working people lose their personality, and their interests should be represented by a manager or a committee. One of the vital changes resulting from this growth of corporations is the liability of the employer to the employee for damages received while in the employment of the corporation. The old common-law rule relating to the liability of employers for accidents occurring to their employees is that a workman cannot recover damages for injuries received through the carelessness or negligence of a co-employee, although a stranger may recover for an injury following the same carelessness or negligence. This rule grew up under the domestic system, when employer and employee worked side by side. But when expanded methods are introduced this old rule becomes somewhat ridiculous. Yet, as the common-law rule grew up before great industrial enterprises were established, courts have been governed by it; but now it is being broken down by statutory restrictions in different parts of the world, although it still holds good in many States. There are very many other points where changes in relationship have been made by the change in system. Looking the field over broadly, the conclusion must be reached that on the whole the working people have been gainers during the progress of the past century — gainers not only in wages, both real and nominal, but in their relations to society.

To a very marked degree, as was long ago pointed out by De Tocqueville, the American nation consists of workers. Such wealth-aristocracy as there is in the country is almost always traceable back by the remove of a generation or so to a hard-working ancestor, of "the laboring class." At the present time the younger members of very wealthy families are devoting their time and service to labor as assiduously as if their subsistence depended upon their earnings. In America, therefore, labor holds a more honorable place in the minds of all the people than it does in any other land, and individuals can look forward to the highest class of associations, both social and intellectual, as a result of their application of skill, provided always they are ruled by integrity, and shall build up a character which will sustain itself under all conditions. A study of conditions, however, proves that the base of the social structure is growing narrower as time, as education, as a wise altruism lead men out of their lowly conditions to a better plane; and the American laborer everywhere is an active, earnest, and, I believe, an honest factor in keeping up the struggle to secure a higher standard of living.

Our 18,500,000, and over, of wage-earners constitute a vast body on whose prosperity, intelligence, and moral worth is based the welfare of the Republic. With their happiness goes the happiness of the whole people. But they demand something more than is indicated by contentment, for their experience with American inventions and educational systems teaches them that from rude instruments of toil they have become intelligent factors, in both a social and a political sense. So it is they join in the great struggle to lift themselves to a higher plane of living. All the disturbances which we have seen during the past score of years, and which seem, superficially considered, to indicate that we are approaching an industrial war, are but protests against fixed conditions. These disturbances often arise from unwise considerations and from ignorance of the conditions of production, but they all indicate one grand trend, and must be considered as a part of the progressive movements of our age. These views constitute the chief elements of what is known as the labor movement, in which American labor has actively participated for a great many years — first, seeking organization; second, by organization, making its protests and issuing its demands. Philosophically, these protests and demands must be viewed as educational factors and not as war factors.

"Labor," Ruskin says, "is the contest of the life of man with an opposite; the term 'life' including his intellect, soul and physical power, contending with question, difficulty, trial or material force. Labor is of a higher or lower order as it includes more or fewer of the elements of life; and labor of good quality, in any kind, includes always as much intellect and feeling as will fully and harmoniously regulate the physical force." So the struggle of the wage-earner becomes of that high order which insists upon recognition as a factor in securing to all people something beyond the mere wants of existence. A man who is working simply to secure food, shelter, and raiment, that is, the conditions absolutely essential to keep him an efficient working machine, is not the best product of civilization; but the man who is willing to work industriously to secure these absolute necessaries to make his services efficient, and then, over and beyond them, something of the spiritualizing necessaries of life, is a credit to our civilization; and these spiritualizing influences can be secured only when, after paying for the necessary lubrication of his working muscles, he is able to furnish himself and his loved ones with elements of life which have heretofore been considered luxuries. He must be able to secure something of these higher elements, or he loses, and retrogression is the result. He must be able to educate his family, and to give them of the best things of life to such an extent that they become active participants in the results of invention, which throw around life everywhere more than could be secured under old conditions.

From what has been said it will be clearly understood that conditions are not always favorable; that there are fluctuations, business depressions, having their discouraging influence, and strikes, unsettling the public mind. The clash between ethical and economical conditions leads to disruptions sometimes in business associations, and arrays, to all appearances, capital on the one side and labor on the other, and gives color to the occasional prophecy that this clash will lead to bloody strife. The causes for this clash are mostly ethical, growing out of the relations of men and the lack of appreciation of the duty which is owed to the public. Macaulay said that the evils arising from liberty were only to be cured with more liberty. So the evils

which apparently surround us at the present time, and which apparently grow out of the industrial world, are the results of an intelligence which did not exist in the past, and the cure for them is more intelligence. Capital and labor are intelligent enough to get into difficulty; they are not always intelligent enough yet to keep out of difficulty. It requires a very high moral character on the part of both employer and employee for each to recognize the rights and the privileges of the other; but with this recognition, quarrels, as such, will largely cease, and contests of mind will take the place of those unhappy contests which are now so frequent. When the employee recognizes that his highest social duty is to render the very best service of which he is capable, and the employer recognizes that his highest social duty is to compensate the best service with the best wage, a vast deal of friction will be avoided. Integrity of business involves both the employing and the employed elements of society. Confidence in each other is the surest cure for many of the difficulties, and while the world is growing altruistic, it will not grow altruistic at the expense of individual development; but after the rendering of the best social service there will come a co-ordinated force involving both altruism and individualism. Either means destruction in a degree. Co-ordination means success and reasonable happiness. The ethical force cannot rule at the expense of the economical, nor can the economical force rule at the expense of the ethical. Their co-ordination is the true line of progress. As American labor comprehends this more and more clearly, and I believe it is comprehending these principles, and as the employer comprehends them more and more clearly, we may hope for the adjustment of difficulties on a plane of moral responsibility not yet reached, except incidentally. The settlement of labor controversies is one thing, their prevention another. If the intelligence of different elements has not reached that degree whereby they can be prevented, then there should be some recognition of that settlement and adjustment which recognize the importance of each side in the success of industrial enterprises.

Carroll D. Wright,
U. S. Commissioner of Labor.

American Legion of Honor, a beneficial fraternal organization founded in 1878; reported for 1902: total membership, 6,386; grand councils, 8; sub-councils, 260; benefits disbursed in its last fiscal year, $628,156.

American Literature. A hundred years ago and for half a century afterward, every assembly of students in this country was entertained by discussions on a "Possible Literature" of America,— how soon there would be an American literature was a favorite question, grief or complaint that there was not an American literature came in if the speaker or writer were of cynical vein. The introspection which was thus developed among people who were born for something better than introspection had its good results. Every printed word, one may say, was collected, which showed that between 1602 and the 19th century, any man or woman had written anything in America. Such a collection as Samuel Kettell's 'Specimens of American Poetry' shows the eagerness with which critics who were forecasting a glorious future for our literature were willing to preserve all the crystals from the past and eager to persuade us that they were jewels. The truth seems to be that for the 17th and 18th centuries there was no class of men or women who would now be called "literary people." At the same time, the new settlers and the men and women of half a dozen generations which followed, said what they had to say, and generally said it well. For they did not think much about the way of saying it, they did not talk much about it, they had no professional critics. There were among them those who "harked back" to English models. After the establishment of newspapers (see Newspapers), which runs back to the year 1704, the sad necessity of journalism (q.v.) compelled the press to create every week a given number of square inches of what is called "matter." Thus, there appeared in the three cities a few of those writers who have to write as much when they have nothing to say as when they eagerly proclaim something not known to the world before.

It was not until 1555 that in the printed books of England the first fruits of the discovery of America appear. Richard Eden then published his translation of Peter Martyr's 'Decades,' and he adds to them some new narratives of voyages not described in the original. An English translation of Ribaut's 'Florida' was printed in 1563. In 1576 the first edition of Sir Humphrey Gilbert's plea for a northwest passage appeared, and an account of Frobisher's voyages was published in 1578. In 1582 we touch solid ground as we come upon the name of Hakluyt. The Island of Roanoke has the honor of furnishing the first original American work to English literature. The four letters of Ralph Lane, who was the first commander of Raleigh's first colony, are the oldest American writings now extant of any Englishman and were perhaps the first ever written. They were written 12 Aug. 1585 from what he calls Porte Ferdynando. One of them was to the famous Sir Philip Sidney. They were printed in 1860 for the first time in the Transactions of the American Antiquarian Society. The English archives have now been thoroughly searched and have probably yielded up all that can be found in them of intercourse with America in this mythical century. There are two or three narratives of the adventures of sailors who straggled from Mexico, where the Spaniards had made them prisoners, to the fisheries of the northeast, where they were relieved by the fishermen. The earliest of these is dated in the year 1582. In the collections of Hakluyt and Purchas will be found other narratives of a similar character which struggled into print in one way or another. Professor Tyler in his admirable survey of the subject, places the year of the birth of American literature in the ode of Michael Drayton, published in 1607, the year always assigned as the birthday of the nation, the year of the birth of Virginia, the year of John Smith and Powhatan and Pocahontas.

The history and criticism which belong to this subject have been admirably handled by the Messrs. Duyckinck, by Professor Tyler's 'History of American Literature from Colonial Times,' by Mr. Kettell, who has been named, and by Professor Charles F. Richardson's 'American Literature' (1607–1885). It must

be enough here to say that Captain John Smith in his various accounts of Virginia and of his voyages on the coast, created a real interest in that "brave new world which hath such people in it." Dr. Tyler refers also to George Percy, William Strachey, Alexander Whitaker, John Pory, and George Sandys. The original editions of the publications of these men are now among the most interesting nuggets of the book collectors. The Hakluyt Society has republished many of them and has proved its value to the students of our early history. There is one interesting tract of Strachey's which would answer one pathetic question. He says, "Before I have done I will tell you the story of the lost colony." But in nothing that has been found of Strachey's is that history told.

That school of historians whose habit is to draw a blue pencil, as the trade says, across everything entertaining in history is fond of stamping John Smith as a liar wherever he goes outside Sandy Hook or Lincolnshire or the Strand. It is the fashion of to-day to throw the story of Pocahontas overboard and even Dr. Tyler, who is sympathetic, calls it the "fable of Pocahontas." But this is to be said, when 100 men trained like cockneys, embarked on an unknown sea, explored an unknown bay, tried the adventure of an unknown river, talked in an unknown language with a savage chief who has never heard of such people before, the incidents of such acts when written by them will not be exactly like those of a London counting room or of a college lecture room. The Hungarian gentlemen, I believe, find Smith's account of Hungary and its Turkish wars intelligible and reliable. Smith's surveys of Massachusetts Bay are entirely intelligible and show an accurate acquaintance with the region which he describes. Now, it is hardly fair when you can verify an old author's personal narrative in nine cases out of ten, to say in the tenth case that he is a liar, simply because you have no material for verification, on the one hand, or contradiction. on the other. Close after the little series of Virginian writers came the series of the Massachusetts historians. They also have been most carefully edited; and it is now only by a fortunate accident that a student of to-day is able to add any anecdote new to other students regarding the first generation of New England. The journal of William Bradford, one of the first governors of the Plymouth Colony, has a story which is dramatic. With a fortunate prescience of the value of every word which related to the Plymouth emigration, William Bradford wrote the 'History of Plymouth Plantation.' His sons and indeed all the people of the old colony knew of the exceeding worth of this volume. It was used by Morton, Prince, and Hutchinson and the others of our earlier historians. A great part of it was copied and from the copy thus made it was consulted by our historians till the year 1855. In that year a quotation from it, which was not in our copies, appeared in Bishop Wilberforce's history of the English Church. On inquiry it proved that this gentleman had consulted the original which was in the Library of the Bishop of London in Fulham Palace. He immediately gave permission that the whole should be copied on the request of Mr. Charles Deane. Subsequently, as a result of the efforts of Senator Hoar, the various authorities in England gave back the precious manuscript to the State of Massachusetts, and it is now one of the treasures most sacredly preserved in the State House in Boston. As Dr. Tyler calls Drayton's ode the beginning of American literature, the Massachusetts people may well call William Bradford's chronicle the beginning of the literature of New England. It should not be forgotten, however, that the letters containing the accounts of Gosnold's unsuccessful colony in 1602 were written before the time when Bradford began to write his history.

When the larger colony of Massachusetts Bay was formed the general court of that colony, according to a very early record, directs that paper books shall be furnished for preserving all journals by the first settlers. Fortunately for their successors, Governor John Winthrop in the midst of all his other cares used his manuscript books, and his notes made almost daily are now cited as Winthrop's 'History of New England.' They cover the period from 29 March 1630, when he sailed from England, to 11 Nov. 1648. It is a convenient aid to memory that Winthrop's death followed close on the execution of Charles the First. Sadly enough all the other blank books thus furnished seem to have served other purposes from that for which they were intended. They were perhaps, used for sermons now forgotten, or possibly for cartridges so soon as cartridges were invented. Such materials for the early history as have been preserved have generally been printed by the care of historical societies or similar agencies. There is a charm about them such as belongs to all fresh narrative where the writers are thinking of the thing done and not of the methods of expressing it. This charm which hangs around Columbus' 'Letters'; Sir Thomas More's 'Utopia'; Defoe's 'Robinson Crusoe'; Swift's 'Gulliver's Travels,' is the same charm which is to be found in Purchas and Hakluyt and the early narratives of those who wrote by the light of a pine knot with pens made from a bird's wing. In such simple utterances we are to look for the first handiwork of American literature.

The first graduates of Harvard College made a class of nine young men, six of whom sought their fortunes in Europe. The year of their Commencement was 1642, and the theses are preserved in which according to the custom of their time, they offered to defend 54 propositions against all comers. It has been observed by modern critics that all these propositions are now known to be false. This is a somewhat cynical statement with regard to them. But when one learns that these young gentlemen were prepared to prove that Hebrew is the mother of languages, one looks with caution upon their courageous statements on other points with regard to the heavens or the earth, the sea or the skies. Four of the number became clergymen. The name most distinguished in history is that of Sir George Downing, who did not distinguish himself for the courage of his convictions.

As early as 1639, the government of the colony had cared for its future education by the establishment at Cambridge of a printing plant. This was done almost simultaneously with the establishment of Harvard College by the same authority. And it was a good omen that the first publication ac-

credited to the new printing house was the 'Freeman's Oath,' as ordered by the general court, to be taken by those who were chosen into the company. Universal suffrage was not yet dreamed of even by Sir Thomas More. The first book which can be called a book which appeared from the press, was the 'Bay Psalm Book,' the work of Thomas Welde, John Eliot, and Richard Mather.

John Eliot already looking forward to his work among the Indians was making his first studies of the language of the people for whom he cared. The modern students speak of this language as the Natick dialect of the Algonquin tongue. Eliot's work was of the first importance and before he died the publications in that language alone of books printed either in our Cambridge or in London makes a department in literature of more than 30 volumes. These books were printed to be used in wigwams and log cabins. The copies which strayed into libraries were but few and those Indian books of that century which remain are among the rarest treasures of the collectors. Of Eliot's 'New Testament' in the first edition there are but 14 copies. Of the second revised edition, published more elegantly, there are 39 copies. The work that Eliot gave in translating the Bible into the Algonquin tongue has been spoken of more than once as work thrown away. But to say this is absurd. Eliot proved himself to be one of the first philologists of any period of literature. His analysis of the Indian language is to this moment a guide to those who choose to study it. With the progress of discovery it has proved that the Algonquin language, of which the Massachusetts language was a dialect, was the language of more than half the Indians of our part of the Continent. To this hour it is spoken by the Catawbas who are living in North Carolina, the Pamunkeys who are living in Virginia, by the Delawares who have been carried from Delaware Bay to Kansas, by the Micmacs, Penobscots and other Indians of Maine and of the northeast, and even by the Arapahoes in the west. Northward and westward it is spoken as far as the tribes of the great Ojibwa family, far beyond Lake Superior, and often near to the Arctic Ocean. Of 300,000 Indians, more or less, now in the territory of the United States, more than half would have been understood in conversation by Massasoit and Philip. An admirable bibliography of Algonquin literature has been prepared by James Constantine Pilling. It is published by the United States Bureau of Ethnology. The work of devoted Moravian ministers in Pennsylvania in the same lines belongs rather to the next century.

Among the early settlers of Massachusetts was Anne Bradstreet, a girl of 18. She was the daughter of Thomas Dudley, who became the second governor of Massachusetts. She was the person called the «Tenth Muse» by Cotton Mather. Her poems, many of which were written before she came to America, are an interesting and curious memorial of the better educated colonists. She lived for most of her life at Andover in Middlesex County in Massachusetts Bay. The most diligent search in her poems shows hardly any reference to the outward aspect of the country in which she lived. Her flowers and her birds belong to the flora and fauna of England and not of Middlesex County. Between 1642 and 1700 Increase Mather and Cotton Mather, are the names most often referred to as we look back on our literary history. Of Increase Mather we have in print 85 publications, mostly separate sermons. Of Cotton Mather the collection is much larger, the number of titles being 382. The modern fashion is to speak of the Mathers with a sneer as bigots and to dismiss them from the lofty consideration of our time. But whoever remembers the duties to which they had to put their hands is disposed to regard them more favorably. There was but little subdivision of work for the men who had been educated to be the leaders of their country. And certainly some allowance is to be made for ignorance of the laws of electricity when the teacher whom you are judging has to study his electricity as Cotton Mather did while he encourages soldiers for warfare, while he checks the smallpox by inoculation, while he is writing the history of the past and is caring for the poverty of to-day. Franklin says in a letter of his to Cotton Mather's son, that if he himself had been of any value to the world, he owed it to Cotton Mather's 'Essays to Do Good.' It is rather hard to throw Cotton Mather overboard either as a quack or a fanatic when such a man as Franklin was willing to write for him such an epitaph. It is fortunate for this generation that at a comparatively early period of his life Mather brought together in his Magnalia historical papers which he had already written, some of which had been printed. The date of the first edition of the Magnalia is 1702, but the work belongs almost entirely to the 17th century. Cotton Mather was himself born in the year 1663, so that a good deal of his record of the history of the first settlement is put on paper at second hand. Occasionally an unfortunate error here has puzzled his readers. For instance, before the discovery of the original Bradford manuscript, we owed to Mather the statement that the Pilgrim Fathers came from Ansterfield in the county of Yorkshire. This proved to be the misprint of the London printer for Austerfield. It was only on the discovery of this error by the late William Hunter that the American pilgrimages to Scrooby and Austerfield begun. A good deal of injustice has been done Mather from what is in itself a comparative trifle, that his great book has not yet been edited by any competent editor. Even the detail that there is no decent index to it has greatly diminished its usefulness to historians in this generation. They ought to remember that he was but 39 years old when it was printed, and the corrections to his work which a man makes between 39 years of age and 60 nowhere appear in it. The reader is referred to the articles MATHER, INCREASE; MATHER, COTTON, and MATHER, SAMUEL, which in their place state what these men did for the growing colony during the period when it ceased to be a trading company and became really an independent State.

Thomas Hutchinson, a governor of Massachusetts, was a man of letters. And if he had not been the unfortunate governor whose disloyalty to the State gained for him the hatred of those around him, he would have been remembered with gratitude as such. He was an enthusiast about the history of the Pilgrims and of the fathers of Massachusetts. The first

volume of his ‘History of Massachusetts’ was published in Boston in 1764, and the second volume in 1767. Alas, he was not equal to the duties of a great crisis, he deserted his countrymen, and by his country was branded as a traitor. But for this he would be named to-day as the first in the series of distinguished American historians.

The assiduous and successful attention which has been paid to the century of colonization has very naturally given to New England readers a better history of what passed in the 17th century than we have of the first half of the 18th century. During that time the people of the United States were involved in war with France. This meant for them a frontier war in which every savage was commissioned by French or Jesuit authorities to descend upon the borders of the English settlers. Excepting the stories of frontier warfare, there was not much to write history about. There are a few exceptions but in general the crown governors sent over by William and Mary, Queen Anne, or by the first Georges were but a poor set. They initiated nothing and were well pleased if they could avoid a quarrel with the colonial assemblies. The one distinguished royal governor is William Shirley, who filled so well the duties almost unexpected, of a commander in chief of North America. So it happens that in reviewing the literature of the country we have no longer such unaffected and simple narrative. But we find ourselves more in the walks of religious speculation and of theology. In the front of the writers on such subjects is Jonathan Edwards, who challenged the attention of the learned in the English-speaking world by studies and results which have become famous. In the penury of frontier villages, and living day by day in what seems very petty surroundings, this distinguished man elaborated his studies on the divine counsels and placed his poor limits on the infinite in methods and language which will survive all other American literature of the first half of the century. It is inevitable perhaps that in the midst of such discussions of the Idea, there shall appear on the other side of the horizon discussions of the fact, or of those realities which men can see with the eyes and hear with their ears. And in our case, Benjamin Franklin was born into the world in the year 1706. Before he was a man he was well advanced in those studies of the English language which gave him afterward his power to express himself to men. Long before he was a statesman and diplomatist, he was conducting his experiments on electricity and when he drew the lightning from the skies, he attracted the attention of all the learned world of his time. When we speak of the American authors of those 50 years the fame of Edwards and Franklin overshadows all the rest. With the discussions attendant on the American Revolution, a new school of authorship began. It now seems clear enough that the more thoughtful leaders of English opinion were from the very beginning amused, not to say delighted, with the simple dignity with which such men as the Adamses, Franklin, Dickinson, and the great Virginia statesmen conducted the discussions, whether of matters of trade, of taxation, or of government.

«History, my Lord,» said Lord Chatham, in his famous address to the House of Lords, «has been my favorite study. . . . I must avow that in all my reading, and I have read Thucydides and have studied and admired the master states of the world, for solidity of reason, force of sagacity, and wisdom of conclusion, no nation or body of men can stand in preference to the General Congress at Philadelphia. The histories of Greece and Rome give us nothing equal to it.»

To this moment, indeed, no careful student of constitutional law or of the foundations of states can go forward in any intelligent inquiry without reading with care the work of the American statemen of that time.

It is interesting to observe that at the same time, perhaps from the same cause, the theological literature of America becomes less and less interesting. The mind and heart and soul and strength of the educated men of America was steadily drifting into an interest of the present relations between God and man and the present sway of the eternal law, much more important to men and women, and among the rest, of men of letters, than theological explanations of the secrets of the universe. The student of to-day finds it worth while to read the publications of Thomas Mayhew, of Boston, of Dr. Witherspoon, of Princeton, of Dr. Samuel Johnson, of New York. But this is not because he cares so much for what is called theology in its narrow definition, but because these men enter as champions of the people into that larger theology of men who really believe that they themselves and all men may be partakers of the divine nature.

Franklin with his genuine instinct for «Together» did not live long in Philadelphia without bringing together one and another club of men of inquiring disposition. One of these clubs still exists in the American Philosophical Society (q.v.). Another founded the fire department of Philadelphia. And, indeed, most of the activities which had given that city distinction, even before 1775, may be traced to such origins. Franklin's own newspaper, the ‘Evening Post,’ may be spoken of as really a literary journal. ‘Poor Richard's Almanac’ (q.v.) was not only an index of time and weather, but it was in its way a philosophical treatise. It was soon translated into French. Le Bonhomme Richard was known in French hamlets which knew nothing of the tea tax or the stamp tax. So soon as peace was declared such institutions as the American Academy of Arts and Sciences, as the Massachusetts Historical Society, as Tammany in New York, which was originally a scientific and philanthropic institution, came into being. The governors of the colleges took new courage; and Commencements and the celebrations which accompanied them gave good occasions for such appeals or lamentations with regard to an American literature, or the want of it, as gave a healthy stimulus to the literary life of the new nation.

A curious illustration of the increasing confidence in home and the literature of home, as years went by, would be found in the series of college addresses of which the first were published at Cambridge in 1796. The Phi Beta Kappa Society, founded in 1776 at William and Mary College in Virginia, soon outgrew its first limitations; and its annual exercises at Cambridge and New Haven were attended by graduate members who liked to renew their college

memories. Branches of it were founded in Brown College in Providence, in Dartmouth College in New Hampshire, and as years passed on, in other similar institutions. The early addresses by scholarly men in these societies were almost uniformly exhortation that the people of America might pay more attention to scholarship and literature. Meanwhile, and under such incentives, there grew up of course in one centre or another, small coteries of literary men and literary women. With an amusing regard to tradition such men seemed to have felt that there could be no literature without an epic or two on which it should be built. Timothy Dwight's 'Conquest of Canaan,' Joel Barlow's 'Columbiad,' which are all but forgotten, and several others which are forgotten, were the results, almost of a sense of duty in this regard. No one can suppose that either of these men was inspired by any divine inflatus of the poet. As you read the dreary lines you feel that the writer thought that there must be an epic and that because there must be he would write it, with the same feeling that a column of soldiers storms a redoubt. By the side of such men, however, there came to be naturally men and women who loved to clothe great thoughts or charming with fitting dress. There came, more and more, to such men and women, as there were, more and more readers to sympathize with them. And as popular education and wealth and leisure, and above all, freedom, brought upon the stage such men and women, the literature of America such as it is to-day was born.

It is interesting to see that almost all of the early books which we should now class as "efforts" in literature, were published by subscription. And there is something pathetic in the memoirs of the earlier literary men where they describe their personal visits from place to place as they solicited subscriptions to pay for the printing of their books. President Dwight himself visited the camp of Washington in 1775 and obtained the subscription of Washington and the other distinguished men around him for the publication of the 'Conquest of Canaan.' The reader must remember that the practical introduction of stereotyping in England or America is as late as the beginning of the 19th century. It was necessary, therefore, to test the market in some way when a book was first printed, so that the printer or publisher or author might know how many copies should be printed. It must be remembered, also, that the printers had no capital which would enable them to keep in type the cumbrous pages of a book which passed the size of a pamphlet. Paine's 'Common Sense,' in 1776, was probably the first book which attained at once a circulation in the least approaching the large editions of to-day. The trade, as the book-selling community still likes to call itself, now begins putting out as a feeler a small edition printed from stereotypes. In our day in a vault in the side of a mountain, or perhaps in a vault under a sidewalk we preserve such plates from which a book has been printed, and according as the demand may prove, new editions can be issued at a comparatively small expense. But up to the year 1813 there was no such resource.

A great publisher is on record as saying that when you have sold 5,000 copies of a book, you know you can sell 100,000. But that before the book is printed no man or woman can do more than guess whether it will have 1,000 readers or 1,000,000. There is a great truth hidden in this exaggeration. See AMERICAN PUBLISHING.

The pecuniary poverty of the printers of the end of the 18th and the beginning of the 19th century caused many American authors to go to England for the printing of their production. Barlow's 'Columbiad' was printed in England Irving's books appeared first in London. Indeed, Irving's wide reputation may be said to have been English before it was American. And he spent much of his early life in Europe, perhaps from the feeling that for a man of letters Europe was a home while America was a wilderness. James Fenimore Cooper made Europe his home for many years, feeling apparently that he could not find society of his own kind in his own land. The same is true of other American writers as far down as the thirties of the 19th century. That was the worse for the infant literature of the nation. Writers watched painfully for the expressions of English criticism, and one line from a Grub Street critic was sweeter to them and worth more than any words from their own countrymen. It is indeed impossible to overstate the effect which was eventually produced by the "American system," as it was called, in the discussions of tariff legislation which followed the short war with England. From the moment when the American printer could send out to the world books as well printed as the printers of England, one may trace new strength in American authorship. The International Copyright law of 1891 compels the publishers of all books which claim American copyright to print them in America. In a truly celebrated article in the 'Edinburgh Review' of 1820, of which no other line is remembered, Sydney Smith said, "Who reads an American book? who looks upon an American picture?" The men who painted American pictures were very mad, as their vernacular would say; and the men and women who wrote American books were equally mad. The writers had a better chance to express their anger than the painters. The sneer implied was the more cutting because for most purposes of literature it was true. Possibly it had some share in the growth, almost from that moment, of a literature which can fairly be called American. The worst of it was, perhaps, that Sydney Smith was in an advance guard of the Liberals of England. He could not be called the product of an "effete civilization," and his words could not be ascribed to Tory jealousy. American readers had known how to prize him and they read his articles if they did not read their own. But really an American author had little right to complain so long as Mr. Cooper called a woman a female simply because Walter Scott did, so long as our writers knew more of Robin-red-breasts and bulfinches than they knew of bluejays or mocking birds, so long as their best actors came from England as every play upon their stage was English, and so long as their scholarly men read the 'Edinburgh Review' and the 'London Quarterly' and the 'New Monthly Magazine' as they read no American journal. The American college boy knew much more of the loves and hates of literary men in England, one might almost say, than the English boy of the same time did.

The English reviews and magazines passed from hand to hand in the American reading rooms while their American rivals died a slow death due to the incompetency of most of the writers. But as the 19th century advanced the tide turned. Dr. Holmes in a happy phrase, quoted as often as Sydney Smith's which has been cited, fixes Emerson's first Phi Beta Kappa address as "our intellectual declaration of independence." I heard the address in 1837, and half a century afterward I heard his second Phi Beta address. Whoever will compare the two will see what Dr. Holmes means. To the thoughtful reader now it seems impossible that Emerson's first address should have seemed extravagant or in any way, indeed, out of the common to the men of that time. But it did seem so then.

It is true that ever since the century began such addresses on Commencement Days or on other literary occasions, have still given four fifths of the time to pathetic appeals to young men to create an American literature. The orators, generally, clergymen or lawyers, did not understand that such books as Lewis and Clark's journals were American literature, that Pitkin's statistics was a book of American literature, that Flint's 'Mississippi,' or Pike's 'Adventures' were vigorous bits of proper national literature, that the Constitution of the United States or John Adams' proposals for the State constitutions were American literature, as much as the Waverley Novels belong to Scotch literature, or Petrarch's 'Sonnets' to Italian literature. But by the middle of the 19th century, people had found out that literature is not a thing by itself to be worshipped and loved like some lonely classical statue in some separate shrine in a gallery, but that literature is simply the expression of what is. In the matter of American literature it proved that Americans had to state for the world the foundation principles of government. They had to describe for the world physical features of a continent of which the larger world knew nothing. And even the language in which they spoke would bear the marks of the climate, the soil, and the history of that continent. So soon as we throw aside the follies of talking about literature as literature and of worshipping it as a separate idol, so soon American literature can be spoken of as a thing in any sort distinct from the literature of the feudal system or other literature of the ancient world.

To review in the very briefest way the literary advance of the nation from the era of independence to the 9th of March 1904, we have to look first at the speeches and letters and pamphlets of the statesmen; and next at the reports of the explorers. There are individual poems and a few sporadic books in prose which linger in the remembrance of antiquaries,— Philip Frenau's Revolution poems, one or two sermons, perhaps may be classed among such memorials. To speak in a broader sense the first work of Irving stands as the first work in the large calendar of our modern literature. His amusing studies of early New York were known then, but the 'Sketch Book' as it was published in London in the years between 1820 and 1822 at once obtained a wide reputation, both in London and in America. Irving showed from the first that he could handle American subjects with a pen as light and a fancy as charming as gave life to Bracebridge Hall or his other English studies. In 1825, when Navarrete first published in Madrid the original documents of Columbus' voyage, Alexander H. Everett, who was then our Minister in Spain, called Irving's attention to these invaluable memoirs and suggested his work on the life of Columbus. Irving went at once to Madrid and was attached to the American Legation there while he studied the subject which is so closely identified with his name. And afterward, when the Spanish people received him as our Minister there, he enjoyed his well deserved fame. Here was an American who could meet English writers on their own terms. Irving was master as well as they of whatever is meant by style or method in literature, whatever secret of the guild there is.

In our time there is no longer a patron who shall endow a book as an emperor might endow an opera house at his capital. For a time or a nation without patrons, you must have such patronage of the public in advance as Dr. Dwight sought for with his subscription book; or, as it has proved, in 150 years, you must have magazines. This means, if one speaks to the Philistines, that you cannot have large wholesale business, no, and you cannot have manufactures unless there be retail business. Dr. Johnson and Oliver Goldsmith had found this out when they worked for Cave and the 'Gentleman's Magazine.' (See PERIODICAL LITERATURE.) One and another adventurer tried the magazine experiment in Boston, or Philadelphia or New York. But alas, the printers of the magazines were almost as poor as the authors were. The people of the country also were very poor in other affairs. As late as 1834 Dr. Holmes wrote for the 'New England Magazine' the first papers in the 'Autocrat of the Breakfast Table.' But the 'New England Magazine,' even with such contributors, died for want of readers. The new series of the Autocrat, in 1857, begins with the words, "As I was saying when you interrupted me," which referred to the death of the first series a quarter century before. Still, the names of those old magazines are interesting grave stones which show the roadway for a struggling national literature. The 'Harvard Register' of 1807 is one of the earliest. The Lyceum follows the Collegian, Harvardiana, and now almost every university gives this excellent field for the tournament of squires and even of pages who look forward to golden spurs of knighthood. A few lines of the Harvard 'Lyceum' of 1810 may be worth copying. They are from a clever parody of Barlow's 'Columbiad' and describe an early steamboat. They are among the boy amusements of Edward Everett.

So where high Hudson belts his hundred hills,
Winds his wide wave, and York's broad bason fills:
With engine force the fluid fields to plough,
The mighty Steam-boat points his sailless prow.
Knees from the winds no gales, the sea no tides,
Whirls the wheel oar, and o'er the river rides.
Lo with what art the nice machinery turns,
With what fierce force the pitchy pine pole burns.
See the black Boiler, in whose darksome womb,
The prison'd water vapours into fume:
The hollow Cylinder, whose shining side
Cramps the crook'd Chain, and turns the densing tide:
Etc., etc., etc.

Of those of the magazines proper which were manfully and loyally sustained for many years is the 'Knickerbocker' which was published in New York monthly for several years. Most

of the authors who won distinction in the literature of the century made their maiden contributions to its pages. In Boston a beginning, which proved to be a foundation, was made in the issue of the 'Monthly Anthology,' of which the first number was printed in 1809. It was the work of a literary club, and it is very creditable to the literary life of the day. Some original translations from the minor poems of the great German poets slipped in. And by this time, America had found out the resources of the German colleges. George Bancroft, Frederick Hedge, Edward Everett, Henry F. Quitman, George Ticknor studied in the German colleges. The success of the 'Anthology' and perhaps a certain jealousy of the literary tyranny of the 'London Quarterly' and the 'Edinburgh Review' led William Tudor, with the spirited young fellows who wrote for the 'Anthology,' to announce the 'North American Review' of which the first number was published in 1815. It may be said of the 'North American Review' that a desire to imitate the English quarterlies weakened it for perhaps a quarter of a century. But its tone was always dignified and on really national questions it was American. In the earlier numbers of the 'Review' it admitted poetry and some short articles which did not pretend to be criticism of books. The successive editors of the 'Review' were William Tudor, Edward Tyrrel Channing, Edward Everett, Jared Sparks, John G. Palfrey, Francis Bowen, Andrew Preston Peabody and Alexander Everett, and James Russell Lowell. A few years after the Civil War it was removed from Boston to New York under the direction and charge of Allen Thorndike Rice. In Philadelphia what was called the 'American Quarterly Review' was published under similar auspices.

Meanwhile what had attracted attention at once to a very great extent was the success of Cooper's novels. The later novels of Scott were still engaging the attention of readers when Cooper's earlier stories were published. He had left Yale College without a degree, disgusted with something or other as youngsters are apt to be in colleges, and had joined the United States navy. This as it proved, was fortunate for the literature of America. After the short war with England, he was stationed on Lake Ontario, which was at that time in the wilderness. At his father's home he had already made acquaintance with the wrecks of the Six Nation Indians (q.v.). At Oswego he fell in somehow with the last of the Mohicans. His study of a real forest and his studies of the forecastle of American ships are both genuinely national, and although he could not resist the spell of the "great enchanter," and imitated Sir Walter Scott whenever he got a chance, the early Cooper novels have the great charm of being interesting. To this hour the school boy reads them as his grandfather read them and regards them among his best friends. In Cooper's later novels there may be seen a tinge of ill temper because he fancied that he had not been esteemed fairly by his own countrymen. But the early novels have established themselves in a well assured place in the literature of his country. Few people remember them, but it is said that the German novels on American subjects by Sealsfield (q.v.) were the inducement for a time of the great German emigration which began as soon as these spirited books began to be printed. His German name was Karl Postel.

Meanwhile the leaders of the nation had found out that a republic stands or falls according to the education of its people. It is impossible to estimate the change produced by the early determination of the more civilized States to improve the education of every child born in their borders. At the beginning of the century you might say that there was nobody to buy books, even if angels or archangels had descended from heaven to write them. But even in the middle of the century an army of readers, men and women, had been created. It began to be evident that a good book in the English language had more readers in America than it had in England. It began to appear that the reputations of English writers depended quite as much upon the American readers as upon those of the British Islands. Scott, Byron, Wordsworth, Coleridge, and Southey, had more readers on this side of the ocean than on their own. The same was true later of Macaulay's 'History' and of other books of permanent value. Disraeli said as early as 1845 that America was the present posterity for the Englishman,— that an English author knew what posterity would think of him by learning what the American of to-day thought of him. The creation of such a body of readers led to the growth of a genuine American demand for what could be called an American literature. A school of history grew up first in which Irving had led the way in which the great historical addresses of Webster and the Everetts and other orators were an essential part. The subserviency to English critics diminished as more and more scholars came from France and Germany. It would be fair to say that Bancroft, Prescott and Motley, as historians, Emerson as a philosopher, Longfellow, Lowell, Holmes, and Whittier as poets, made a distinct American school after the year 1830 when Bancroft announced his plan for his history, or more definitely perhaps in 1833. So far as this was a New England school it was somewhat affected by the literature of the Continent of Europe, but this effect has been overstated. Emerson was not at all indebted to Germany in his work. Longfellow's poems are distinctly American when they are not translations. Lowell won his English reputation by the admirably national characteristics of the Biglow Papers. Still a distinct ripple on the tide of literary advance may be found in all the seaboard States when in the twenties of the last century, the Holy Alliance (q.v.) exiled from Germany Lieber, Follen, Beck, and some other young students who had displeased Metternich.

What is familiarly called the Lyceum System introduced an element of value constantly increasing in the higher education. It ought to be remembered that the Lyceum introduced Ralph Waldo Emerson to the people of America in a much shorter time perhaps than any published writing would have done without its assistance. Where the trustees and faculties of colleges would have refused to invite Mr. Emerson to speak, the students of college societies would gladly send him an invitation. Once heard he was of course sure to be remembered. Not to speak of other lecturers who were instructing all the northern states, arousing curiosity as to subjects on which they hardly touched, Ralph Waldo Emerson when he took up the

work of a prophet unlimited by the restrictions of the priesthood led the way in a revelation which has affected all the literature of his time, whether in America or in England. In the smaller New England circle, Margaret Fuller, afterward the Countess Ossoli, by "conversations" and published essays called the attention of many young people to the wider realms of thought and especially to the more modern movements of philosophy and literature.

With the existence of a sufficient body of readers large circulations became possible for magazines. The first which succeeded pecuniarily were those who told the most stories, and it was on the basis of story telling that the 'Southern Literary Magazine,' 'Graham's Magazine,' the 'Godey's Ladies' Book,' and the 'Boston Miscellany of Literature and Fashion' came into being and by their success with the public created the literary magazine of to-day. When a Boston publisher could say in 1841, "We sell 1,000 copies every month to the Lowell factory girls," the word was spoken which showed that a sufficient supply of readers is necessary in the creation of a literature, and will in its time bring into being a sufficient number of writers. The 'Knickerbocker,' the 'New England Magazine,' and the 'Port-Folio' had failed to enlist anything like the public support which waited on all decent magazine work after the public schools had created their army of readers. One and another ineffectual effort was made to turn away the current of the English magazines and to introduce an American circulation in its stead. It is interesting to see that the early numbers of 'Harper' were written almost wholly by English writers and large editions of 'Fraser's Magazine,' of the 'Dublin University Magazine,' and of 'Blackwood' still made up the popular reading of the reading rooms. But in 1857 the 'Atlantic Monthly' was created with such writers as Bancroft, Prescott, Motley, Holmes, Lowell, and Longfellow among its very earliest contributors, and one may say, on its working staff. Lowell was an office editor of the 'Atlantic.' 'Putnam's Magazine,' in New York, sprang full armed into existence It introduced itself by an article which awakened curiosity, and perhaps one may say national pride, on the question, "Have we a Bourbon among us?" From that day to this, magazine literature has held an important part in the work of the better literary men of America.

The short story had been invented in England. The serial story as Dickens and Thackeray had shown, gave admirable opportunities for feeling the public pulse. It is amusing today to read that the publishers of the 'Anti-slavery Standard' doubted whether they should pay James Lowell $400 a year for his contributions to that journal, contributions among which are some of the best poems which he ever wrote. This is only one among the many illustrations which peep out from the books of biography as to what Dr. Johnson or Goldsmith would have called the patronage of the readers of magazines and their editors. The encouragement to authors was little but it was enough. In the year 1849-50 the people who read anti-slavery newspapers began to talk of the serial issues in which the story of 'Uncle Tom's Cabin' was going forward in a newspaper called 'The National Era.' The southern writers on the Civil War ascribe to that book the complete change in American politics and in the questions which led to the war which belongs to the middle of the century. In 1851 the story was published in book form and at once became known not simply in America but in England and in all the literature of the civilized world by means of translations. Its circulation in England, for instance, was the first circulation of a book on what was called popular prices. One edition of it appeared in a newspaper issue at the cost of one penny a copy. Mrs. Stowe's supremacy as a writer of fiction established itself at once and from that moment to this, American literature can make the boast that it has furnished the book of which more copies have been printed than of any other book which originated in the English language. It is a little curious that its only possible rival, if one considers simply the number of copies printed, is 'Robinson Crusoe.' Mrs. Stowe's story is that of a fugitive slave; Defoe's story is that of a shipwrecked slave trader. Since the issue of 'Uncle Tom's Cabin' no American writer has cared to show his acquaintance with the etiquettes of marquises and dukes. The temptations of travel give to the American readers every now and then a good book as where 'Daisy Miller' takes them by night into the Coliseum, or when husband and wife stray together in the gardens of a German watering place. But no American writer selects a European scene from any wish to work for the sympathies of European readers. On our own continent our historians find their themes, our novelists their interests. With the Civil War the dependence upon English criticism and the respect for it died in a night. Up till that time, young America had permitted the distance of the writer to be warrant for his education and his judgment. At that time in the nation's struggle for its existence, it received no sympathy from the writers of England. They had been trained under feudal institutions and they were glad and pleased that democratic institutions were to fail. The young men and women of America learned that for the criticism or for the education which belonged to this nation, they must study their own country. In truth the society of America is American society, the laws of America are American laws. Its prospects and hopes are those of a democracy. As the strata of its rocks and the growth of its trees are different from those of England, so are the foundations of the state and the customs of its administration. It is impossible here to consider in the least detail the methods of different writers who have won the love and admiration of their countrymen in the years which have followed.

The central observation is that as soon as America furnished readers enough a proper American literature followed the demand. As soon as the system of the country made possible first-rate printing offices in rivalry with the best printing houses in England, the American demand for American books could be answered at home. In naming Cooper and Irving we have named the two writers distinctly American whose published work was first everywhere known. Other authors printed their books which were forgotten. There was perhaps something ludicrous in the effort to create aboriginal enthusiasms which did not exist. For instance, any early copy of the 'North American Review'

will show the standing advertisement on the cover that the publishers had a "supply of the 'Yamoyden' kept constantly on hand." The 'Yamoyden' was a poem on a supposed hero or heroine of Algonquin origin named the "Yamoyden." But the publishers spoke of the volume as a commission house might speak of so many bushels of wheat or of barley. Books or essays of purely American type struggled into existence and some of them are still remembered. Edgar Allan Poe was born in the year 1809 and died in the year 1849. Warren Burton's 'District School,' Mrs. Gilman's 'New England Housekeeper,' some of James K. Paulding's sketches and essays were distinctly American. Mrs. Sedgwick and Miss Sedgwick wrote admirable and unaffected books. Edward Everett and Alexander H. Everett with all the advantages of early European training were thoroughly American in their orations and in the work which they did in the 'North American Review.' That 'Review' itself while it imitated aspects of the English quarterlies always carried an American chip on the shoulder and defied all foreign travelers or foreign critics who did not find perfection in everything American. A story of pure American life, most instructive to the student of that older time is Sylvester Judd's story of 'Margaret, a Tale of the Real and Ideal, Blight and Bloom.' Judd was a poet, but this prose novel has proved his best work.

The exquisite genius of Nathaniel Hawthorne would have worked its way through any difficulties. In his own nation his favorite earlier subjects drawn so largely from the traditions of the early centuries, undoubtedly had their share in introducing him to the great body of readers. So soon as he traveled abroad, he showed that he could handle any traditions and was at home in any atmosphere. As in all work of men of genius his temperament and as he says, the traditions of his life, governed to a certain extent his choice of subject. But always it is Hawthorne who is the master and fascinates the reader; and there is no other Hawthorne. In other instances perhaps a certain charm is given in English circles to the naivete of what one may call the frontier habit of the American writer. Walt Whitman had an affectation of expressing a disgust which he did not really feel with all the conventionalities and institutions which did not smell of the pine knot or of kerosine. He is said to be better known in England than in America. This is somewhat as it has happened with an American preacher like Moody and others who could be named, who has won attention even by the accent of his voice. After he had won attention abroad he needed nothing more. We may say again that this is no place to enter into an analysis or other discussion of the work of different American authors and of their hold upon the national life. When one remembers that no prose writer of our country is more likely to be generally read three centuries hence than the despatches of Ulysses Simpson Grant, he hesitates before he shall say who are the literary men. Give time enough and Washington becomes a literary man, and Judge Marshall. But this may be said, that of the 29 heroes in the New York Hall of Fame, Thomas Jefferson, James Kent, Joseph Story, Asa Gray, Jonathan Edwards, William Ellery Channing, Horace Mann, Henry Ward Beecher, Ralph Waldo Emerson, Nathaniel Hawthorne, Henry Wadsworth Longfellow, and Washington Irving, would not have been named among the most distinguished Americans except for their work with the pen. Franklin might be numbered as a naturalist, Washington or Grant as soldiers; but the 12 who have been named won their place simply as authors. And every one who is in any way familiar with their work understands that this work is distinctly American. You could not mistake it. If you read 25 pages from any of these authors, you would know that he was brought up under the institutions of a Republic and that the width of horizon, may one say, comes in as a part of the atmosphere to which in the omnipotence of God the American is accustomed. In naming those to whom the country owes the growth of its literary taste, the charm of great travelers and great historians should be added to the great statesmen. But the list as far as it goes is not useless, for it shows what is the current of average feeling of the people of America. The people of America is sovereign of America and as everywhere the sovereign is the fountain of honor. We could choose no better instance of the encouragement given by the people to the author of first-rate genius and ability than is found in the literary career of John Fiske. Fiske owed none of his success to official position. No distinguished review called attention to the way a young man needed encouragement, but simply Fiske had a great deal to say and he said it. And by the time he said it there was a nation of people who had been educated to appreciate and enjoy what he said. He used to say that even in his young life he was looking forward to history as the study which he was to pursue through his life. The opportunity came for the gratification of this passion. He seized upon the opportunity, and the American people recognized the hand of a master. But Fiske was not to be shut up within any narrow range of study or of authorship. He had his own views of life and duty, of ethics and of destiny, and he wrote them down. He said what he wanted to say in a form which won the sympathy of all thoughtful people, and there were enough readers trained to careful thought to welcome the gifts which in such service he made to the nation. Perhaps in speaking of this instance we are speaking simply of the step forward which the conscience and heart of the whole nation made in obedience to the word of Ralph Waldo Emerson, who gained a welcome in all quarters,— in the miner's cabin or in the sanctum of kiln-dried seminaries. It has been said that of the early volumes of Emerson's 'Essays' millions of copies might be found to-day in the hands of the most ignorant or the most learned men and millions of men who never heard his name are living under the inspiration of his prophecies. It is said by the English critics that Mr. Longfellow's poems are better known by the people of England than are Lord Tennyson's. Perhaps this is true.

It has also been curiously true that more than one English reputation has been first made in America. Carlyle's first books were well known here before the critics of Eng-

land honored them with their approval. The English writers whined a good deal so long as they had no protection at American law for their copyrights. This nation was creating a reading class at an expense such as monarchs never dreamed of, such as England has never thought of, and it was the fashion to chide Americans because at the outset they did not throw open the market thus created to the writers of a nation where there was not one reader for a hundred in America. The International Copyright Act has remedied this grievance. But it has not proved that either the English or American author has gained readers by any of the accidents of publication. The rule holds which Abraham Lincoln laid down so well that the people who like that sort of thing will read that sort of thing. But so far as statistics of the trade in books go, it is evident that the rank and file of American readers are interested in American subjects treated by writers who feel the American impulse and were early baptized in the ways of democracy. It is more necessary to say this in this article because so much of the less important writing for the American daily press of this century is from the pens of men who are educated in the British Islands or on the Continent of Europe. Such men do not fully understand the spirit of the life in which they live and necessarily treat its questions as foreigners.

Of writers now living it is hardly becoming to speak in these pages. The first novelist of this generation born in Ohio, cradled in the midst of the matchless resources of that empire State, still lives young and vigorous, to delight the readers of the English language in all parts of the world. He has occasionally toyed with European scenery and experience, but his work is the work of a true democrat trained to know that men live for each other and in the 20th century each man has to live for each and each for all. After you cross the Mississippi River, when you buy your morning newspaper, the chances are that you find no reference in it to any lands on the eastern side of the Atlantic or the western side of the Pacific. The journalists of that region also have their affectation which compels them to leave Europe and Asia disregarded as they might disregard the governments of Sesostris or of Nebuchadnezzar. For even the names of the leading writers of to-day, whose works are far too numerous to be catalogued here, we must refer the reader to those names separately as they will appear on different pages of this encyclopedia.

Edward Everett Hale,
Author of 'The Man Without a Country.'

American Manufactures. The 12th census marked the close of the first complete century of manufactures in the United States. It thus became the most important statistical basis by which to measure the future advancement of American industry. It was with these words that the final report of the 12th census on manufactures began. It might have been added that the 12th census is the first to occur since the United States has become distinctly a manufacturing nation and has produced a surplus of manufactured goods with which it has entered the world's trade to acquire foreign markets.

History.— In 1791, when Alexander Hamilton submitted his celebrated "Report on Manufactures" to Congress, he was able to refer to the household system of manufacture by means of which each family unit supplied many of its own needs; and he described the remarkable development of this type of manufacture in southern New England, where considerable quantities of coarse cloth, clothing, and nails were produced. In addition to this, some twenty industries were mentioned which had reached a considerable development, involving special buildings, the division of labor, the ingathering of raw materials from distant localities, and the distribution of the manufactured articles throughout the States.

While this was a respectable beginning, the chief task of the American people for at least five decades was to push forward the frontier. Up to 1840 this work went on. By that time compact settlement had reached the Mississippi River, and the further growth of population required the building of railways and the establishment of manufactures. By 1850 the chief forms of labor-saving agricultural implements of American origin were introduced and began their work of liberating an increasing proportion of the population from agriculture. The Civil War increased the need of the country for manufactured articles, and, accompanied as it was by a high tariff to provide government revenue, provided a powerful impulse to develop home manufactures. Down to 1880 agriculture was the chief source of wealth in this country. The last two censuses have shown manufacture to be dominant. In 1900 the value of agricultural products was $4,700,000,000; the net value of manufactured products was $5,900,000,000.

We may group our industrial history into periods, therefore, roughly as follows:

1609—1789	Colonial period.
1790—1840	Period of western settlement. Agriculture for home consumption except cotton.
1840—1880	Period of agricultural dominance. Large export of raw materials.
1880—1900	Dominance of manufactures for home use.
1900—	Period of foreign trade in manufactures as well as raw materials.

General Comparisons.— To gather some of the chief results of the recent census investigation into a few sentences we may say that when we speak of "American manufactures" we mean 512,339 establishments, using $9,835,086,909 of capital, and involving the labor of 397,174 officials and clerks and 5,316,802 wage-earners. This vast equipment consumes $7,348,144,755 worth of raw materials annually and makes out of the same manufactured products worth altogether $13,014,287,498. These figures all show a healthy increase over those of 1890. There are 44 per cent more establishments now than then; 50 per cent more capital is used; a fourth more wage-earners are employed; and the annual value of the gross product is 40 per cent more than in 1890.

In 1810 the manufactured goods produced in this country were worth $27.58 per capita of the population, or $165.48 for the average family. In 1860 manufactures were worth $60.06 per capita, or $318.32 for the average-sized family of that period. In 1800 the per capita value was $149.72, or, for a family of 4.9 persons, $733.63. In 1900 the per capita value of manu-

factured goods was $172.21, or $809.39 for the average family of 4.7 persons.

Classification of Establishments.— There are three ways in which manufacturing establishments may be classified:

1. According to the general economic class to which they belong.

The 512,254 establishments considered by the census as "manufacturing establishments," in the strict meaning of the term, are divided into:

Household industries and repairing	215,810
Manufacturing — other	296,444
To these we may add small establishments producing annually goods valued at less than $500.	127,419
Government establishments	138
Educational, charitable and penal establishments.	383

2. The second classification of establishments is according to the form of organization employed. It is as follows:

Individual ownership	372,703
Partnership	96,715
Company or corporation	40,743
Co-operative association	1,765
Miscellaneous	174

The corporation is the form in which the larger businesses are usually organized, and controls 59.5 per cent of the product. Co-operative associations are confined to the manufacture of butter, cheese, and condensed milk.

3. The third classification is according to industry. The 12th census has given us for the first time a carefully digested grouping of manufactures, as follows:

(1) Food and kindred products, (2) textiles, (3) iron and steel, (4) lumber, (5) leather, (6) paper and printing, (7) liquor and beverages, (8) chemicals, (9) clay, glass, and stone, (10) metals other than iron and steel, (11) tobacco, (12) vehicles for land use, (13) ship-building, (14) miscellaneous, (15) hand trades. Of these classes the most numerous, excepting the hand trades, is the first, "food and kindred products," with 61,302 establishments. The least numerous is that of ship-building, in which there are 1,116.

The Manufacturing Population.— The statistics show that 29,000,000 persons over 10 years of age are engaged in productive industry. A little over a third of these are in agriculture, a fifth are in domestic and personal service, a fifth are in trade and transportation (16.4 per cent) and the professions (4.3 per cent) combined, and a fourth are in manufactures and the mechanical pursuits, including mining.

To this latter fourth belong the 5,713,976 persons engaged in manufacture. In the last 20 years the number of persons in professions, trade, transportation, and manufacture has increased relatively. The number of persons in agriculture has decreased relatively. The domestic and personal service class has remained constant.

The proportion of men, women, and children in manufacturing establishments is such that if a given establishment employing 100 persons desired the typical division of men, women, and children, it would be obliged to employ 77 men over 16 years of age, 20 women over 16 years of age, and three children under 16.

Power.— Half of our manufacturing institutions use power of some sort to supplement hand labor. So liberally and skilfully is power used in the United States that the average output per employee is between three and five times what it is in England. The most prominent fact in the evolution of sources and forms of power is the increase in the use of electricity.

Growth of Large Establishments.— The census shows the increase in the size of plants by showing that, while the product of manufacture has been increasing in almost all lines, the number of establishments has been declining in many of them. There was in 1900 a smaller number of establishments than in 1890 manufacturing agricultural implements, boots and shoes, carpets, glass, iron and steel, leather, woolens, and the products of slaughtering and meat-packing; nevertheless in each of these industries the average capital, the average number of employees, and the average product per establishment increased, and the total product of each of these industries increased.

A more direct but not more positive proof of this tendency is shown by the enumeration of large establishments. In 1900 there were 452 plants in each of which over 1,000 employees worked. Of these 120 were in textile manufacture (one in New Hampshire employing 7,268 persons), 103 were in iron and steel manufacture (one in Ohio having 7,477 persons), 48 were in vehicle manufacture, 29 in food products, 20 in metals other than iron and steel, and 132 in miscellaneous lines.

Turning to the question of industrial combinations we find some interesting statistics in the census. A list of 185 such organizations is presented. They controlled 2,040 plants, possessed a combined capital of $1,436,625,910, employed 400,000 wage-earners and 24,640 officials, and manufactured products annually valued at $1,667,350,949. That is to say, 8.4 per cent of the wage-earners engaged in manufacturing in America were employed by these combinations, and 14.1 per cent of the value of our manufactures originated with them. The census report does not include the United States Steel Corporation or any other combination organized during or since the census year. The steel corporation is largely covered by the above figures, however, since most of its constituent companies rank as combinations. The great dividend-payers among the "trusts" in 1900 were the Standard Oil Company, American Steel and Wire Company, Federal Steel Company, American Sugar Refining Company, Amalgamated Copper Company, Pullman Company, American Tobacco Company, Continental Tobacco Company, and the United States Leather Company.

Localization of Manufactures.— The industries of the United States are generally strongly localized in certain regions. This tendency to develop a territorial division of labor has always been marked in this country, in agriculture as well as in manufactures. The causes which lead to the location of industry in certain places are enumerated by the census:

1. *Nearness to Materials.*— This is illustrated by the oyster-canning of Baltimore.

2. *Nearness to Market.*— The agricultural implement manufacturers of Chicago find their best market in the region which is tributary to that city.

3. *Water Power.*— Fall River, Mass., with its textile manufacture, Cohoes, N. Y., with its

knitting industry, and Niagara Falls, with its electro-chemical industries, have resulted from the utilization of water-power.

4. *Favorable Climate.*— The Piedmont section of the South attracts cotton mills, not only because of its nearness to materials and its water-powers, but because of its favorable climate.

5. *Supply of Labor.*— The garment trades are largely monopolized by New York, Philadelphia, and other large cities on the coast, because there a large population of foreign birth, with low standards of living, furnish adequate supplies of cheap labor.

6. *Capital Available for Investment in Manufacture.*— When the whaling industry declined, New Bedford, which had become wealthy by means of it and was ranked as one of the richest cities in the United States, put considerable of its capital into cotton manufacturing. The city of Chicago was not able to surpass Cincinnati as the centre of the pork-packing industry in the West until the local banks acquired enough money to aid the packers in carrying the enormous financial load of buying the raw materials, which for that business constitutes about 75 per cent of the value of the finished product.

7. *Momentum of an Early Start.*— Sir William Johnston early brought glovers from England to Johnstown, N. Y., and started the industry for which that city and Amsterdam and Gloversville are now noted. Had the celebrated "shoemaker of Lynn" settled in a neighboring village, Lynn might not now signify shoes wherever the name is heard.

If we examine a map showing the location of American manufactures we shall observe that they are markedly concentrated along the Atlantic seaboard, from the middle of Maine to the latitude of Baltimore, and covering a region extending perhaps 100 miles back from the coast. West of this an irregular belt of country, including middle New York, western Pennsylvania, and northeastern Ohio, stands out prominently. Passing still farther west we find the manufactures not so evenly distributed, but rather concentrated at certain points, such as Cincinnati, Louisville, the gas belt of Indiana, Chicago, Milwaukee, St. Louis, Minneapolis, Kansas City, and Omaha. The South shows a large number of small, rather isolated manufacturing localities. These occur most frequently upon the Piedmont plateau, from southern Virginia to northern Alabama. In the Rocky Mountain States and the region west of them, five centres stand out separated from one another by wide intervals of undeveloped country. They are the middle portion of Colorado, Salt Lake valley, the Butte region of Montana, the Puget Sound and Columbia River cities, and San Francisco, with the adjacent cities from Sacramento to Alameda.

The national centre of manufactures has been fixed at a point east of the middle of Ohio, about 25 miles southeast of Mansfield. It has moved west only about 40 miles in 10 years. The centre of population lies 200 miles southwest of this, at a point about 8 miles from Columbus, Ind.

California is first in preserving vegetables and fruits, vinous liquors, lead smelting and refining.

Connecticut is first in ammunition, brassware, clocks, corsets, cutlery, needles and pins, and hardware.

New York is first in 31 industries, among which are butter and cheese, gloves, factory-made clothing, furniture, chemicals, hosiery, malt liquors, lithographing, printing and publishing, millinery and lace goods, paper and pulp, patent medicines, soap and candles, sugar refining, cigars and cigarettes.

Illinois is first in the manufacture of agricultural implements, bicycles, cars, glucose, and distilled liquors, and in slaughtering and meat-packing.

Wisconsin is first in lumber and timber products.

Minnesota leads in flouring and grist-mills.

Texas leads in cotton-ginning and the manufacture of products from cotton-seed.

Some manufactures are limited to very restricted areas, a group of States or a single State or even a portion of a State confining them. The most highly concentrated industry is the making of collars and cuffs, of which 99.6 per cent is within New York State and 85.3 per cent is in the single city of Troy.

The tendency to centralize industry has given rise to cities which are chiefly devoted to one occupation. The city most wholly given up to one thing is South Omaha: 89.9 per cent of the products of this city are the output of the great packing houses located there. A list of cities of 20,000 and over in population, in each of which 40 per cent or over of the industrial products belong to one branch of manufacture, is as follows:

Shoes — Brockton, Haverhill, and Lynn, Mass.

Agricultural Implements — Springfield, Ohio.

Collars and Cuffs — Troy, N. Y.

Cotton Goods — Warwick, R. I., Fall River, and New Bedford, Mass., Lewiston, Me., Manchester, N. H.

Fur Hats — Bethel and Danbury, Conn., Orange, N. J.

Glass — Millville, N. J., Tarentum and Charleroi, Pa.

Knit Goods — Cohoes, N. Y.

Iron — Youngstown, Ohio, McKeesport, Johnstown, New Castle, and Pittsburg, Pa., Joliet, Ill., Trenton, N. J.

Jewelry — North Attleboro and Attleboro, Mass.

Gloves — Gloversville and Johnstown, N. Y.

Pottery — East Liverpool, Ohio.

Silk — West Hoboken and Paterson, N. J.

Slaughtering and Meat-packing — South Omaha, Kansas City, Kan., St. Joseph, Mo.

Cities.— About one half of the manufactures of the United States are turned out in our 100 largest cities. These cities contain 23 per cent of the population. About two thirds of these products come from the 209 cities having over 20,000 population. The greatest concentration of a manufacture in cities is found in the case of men's and women's clothing, hats and caps, cars, umbrellas and canes, lithographing and engraving. The smallest degree of concentration is found in the case of flour- and grist-mills, distilled liquors, and brick and tile.

New York city is most cosmopolitan in its manufactures, exhibiting the greatest variety of

them, and having a number of establishments which are the only ones of their kind in the country. In 1900 there were 39,776 manufactories in New York city, employing $9,250,000 capital and 500,000 persons, turning out goods annually to the value of $1,371,000,000. The most numerous class of establishments in the city was for custom work and repairing of boots and shoes, of which there were 3,341. There were more than 1,000 establishments each for the manufacture of cigars, women's clothing, dressmaking, carpentering, men's clothing, and also for plumbing, painting, and blacksmithing. There was only one establishment each for the manufacture of bells, felt goods, firearms, leather-board, and car-fare registers.

Achievements and the Outlook.— The general causes which have made us a great manufacturing nation, and the advantages which we now possess, have been placed under five headings:

1. *Agricultural Resources.*

2. *Mineral Resources.*— It is plain that a country which produces nine tenths of the world's cotton, one third of its coal, one fourth of its iron ore, and one half of its copper, and a similar generous share of many other things, such as lumber, grain, hides, and petroleum, has a great advantage in the matter of raw materials upon which to set labor and capital at work.

3. *Transportation Facilities.*— These include the remnants of a neglected canal system, a magnificent but scarcely used system of navigable rivers, amounting to 18,000 miles, and a highly important system of Great Lakes, waterways extending for 1,000 miles and carrying a tonnage "equal to nearly 40 per cent of that of the entire railway system of the United States." Our railway system, constructed with great rapidity between 1860 and 1880, is now over a third of that of the world. In 1899 the total length was 189,295 miles, as against 172,621 in Europe, and the cost of moving goods was less here than in Europe, being on the average less than six mills for carrying one ton a distance of one mile.

4. *Freedom of interstate commerce.*

5. *Freedom from tradition.*

As an example of American ingenuity we may cite the invention of the system of interchangeable parts, which has made possible the use of complex machinery in agriculture or other industries at a distance from machine shops or the point of original manufacture. Activity, skill, and willingness characterize the best type of American workmen, and this willingness is shown in part by a readiness to pack bag and baggage and move to those places where manufacture can be carried on most economically, especially if it be to a large city. The organizing ability of American capitalists cannot be doubted. There is scarcely an industry upon which the peculiar genius of the American has not wrought an effect.

In food manufacture we began with the slowly revolving millstone, but Oliver Evans originated the system of automatic conveyors now in use. When later this was coupled with the middlings purifier, also of American origin, and the Hungarian roller process in a modified form, the modern mill first became a reality. Here the factory system was first applied to the making of cheese and butter, resulting in the cheese factory and creamery. An instance of a wonderful application of machinery to a complex process is afforded by our slaughtering- and meat-packing establishments.

In textile manufacture we are now the second nation in the world in the number of cotton spindles operated, and first in the amount of cotton fibre used.

In iron and steel manufacture we have passed our chief rival, Great Britain, several years since, and now English ironmasters who visit us say that nowhere in the world are labor-saving devices so masterfully designed and employed as here. In the using of steel we are quite as original. To this the heavy rolling-stock, rails, and bridges of American railways testify. Here structural steel was first employed in buildings. The structures into which the first girders went are still standing — Cooper Union and Harper's publishing house in New York city. An enormous demand for iron and steel is created for agricultural and mining and manufacturing machinery, and also for electrical equipments and gas and water pipe. Nowhere are stoves and ranges made so large and beautiful as here, and nowhere is tin-plate used so lavishly. In lumber, leather, paper, and other lines the record is similarly encouraging.

EDWARD D. JONES,
University of Michigan.

American Mathematical Society, an association established in 1888 as a local organization in New York, and reorganized in 1894 under its present name, to encourage an active interest in mathematical science. Membership 400.

American Medical Association, a society organized in 1847 to foster the growth and diffusion of medical knowledge. Membership upward of 12,000. Its chief publication is the 'Journal' of the association. Office of secretary, Chicago, Ill.

American Merchant Marine, The. International commerce and communication between nations by means of ships have always been prominent factors in the development and growth of a nation, and by their relative importance at any period, the power and position of a country among states may be estimated. The growth of the mercantile marine of the United States after independence had been declared and after the War of 1812 affords ample demonstration of this fact, as also does the decadence that ensued consequent on the Civil War, and contributory causes, the declining point of which is definitely located in the decade between 1855–65. Prior to this latter period, and following on Jay's treaty of 1794 (q.v.), the mercantile marine of the United States developed at a conspicuous rate. With the exception of the United Kingdom and her colonies, this country possessed the greatest number of ships and the largest amount of tonnage among the nations of the world, and gave evidence at one time of a likelihood of surpassing Great Britain in becoming the most extensive carrier on the universal ocean. Statistics show that in 1859, 66.9 per cent. of the foreign commerce of the United States in imports and exports was carried in American vessels. Six years later, after the Civil War, this had been reduced to

THE OLD-TIME WOODEN SHIP.

THE MODERN IRON SHIP.

27.5 per cent., and gradually decreased until in 1901, it reached 8.2 per cent., since when there has been an increase to 10.3 per cent. in 1904. From second position, the United States had come to rank third after Germany among the mercantile powers of the world; in marine tonnage being surpassed three to one, and on the ocean nine to one, by Great Britain.

While compensation is found in the marvellous internal progress of the country, the development of the American merchant marine also exhibits, besides ordinary material growth, interesting phases which are worthy of examination before detailing in outline the carrying trade of the United States prior to the Civil War, and its subsequent decadence for which various measures of relief have been recommended. Before and during the American Revolution the international struggle for the mastery of the seas precluded any possibility of freedom of trade, and one of the greatest opponents to the development of any foreign merchant marine than her own was Great Britain, now in the first decade of the 20th century, with the United States and Japan the foremost champions of the principle of the "open door" to the whole trade of the world, and of freedom and noninterference in commercial affairs. In maritime relations, Great Britain was still governed by the navigation laws of the 16th century, which had been formulated again Dutch expansion and commerce, while generally similar discriminating and retaliatory measures were in force among European maritime nations against rival merchant marines. Of this nature, illustrating the conditions of international commercial jurisprudence at the beginning of the 19th century, were the Orders in Council, directed against France and the counter attack of Napoleon with the Milan decree. Great Britain's claim of the right of search and impressment, and the refusal of the United States to recognize that right, was one of the causes of the War of 1812, and the opposition of the United States undoubtedly inaugurated the era of oceanic commercial freedom, together with the doctrines of free ports and open doors, adopted and fostered later by Great Britain and so successfully promulgated in the case of China during the Boxer agitation of 1900-01 and the Russo-Japanese war of 1904-05 by the late United States Secretary of State John Hay. Great Britain materially assisted, although unwittingly, in sustaining the principle of the freedom of the merchant marine, when protesting, during the Civil War, against the forcible action of Captain Wilkes of the United States ship *San Jacinto* in boarding and searching the British steamer *Trent* for the Confederate commissioners James Murray Mason and John Slidell who were made prisoners. Secretary of State Seward and President Lincoln gracefully acceded, although against public opinion, to releasing the prisoners, and in so doing admitted that the United States had no right to search a British vessel, and *per contra* Great Britain was deprived of the weapons of search and impressment which, by *force majeure*, she had so long wielded against weaker nations.

Meanwhile the introduction of steam and the great advances in all branches of engineering during the 19th century had contributed largely to the development of the merchant marines of the world, firstly by the improvement of ship locomotion, and secondly by the adoption of fixed ocean routes, the building of great ship canals, of which the Suez and the projected Panama canals are foremost examples, and by the improvements in harbors, wharves, dock appliances and accommodations at the termini of commerce. Of equal importance were the successive changes from wooden to iron hulls (about 1863), yielding larger and stronger ships with better and cheaper service; from iron to steel hulls, a fresh advantage in economy and capacity; the change from paddles to screws about 1850; from simple to compound engines about 1856, securing increased radius through decreased expenses for steam coal; the adoption of twin screws since 1889, and the development of the turbine steamer since 1895.

After the conclusion of the War of the Revolution, the United States merchant marine commenced its national existence. In May, 1789, James Madison, in the House of Representatives, stated that only 160,907 tons were foreign of the 437,641 tons (including repeated voyages) registered as entered in the ports of Massachusetts, New York, Pennsylvania, Maryland, Virginia, South Carolina, and Georgia. "This circumstance," continued Mr. Madison, "annexed to our capacity of increasing the quantity of our tonnage, gives us a favorable presage of our future independence." On 31 Dec. 1789, the merchant fleet of the United States amounted to 201,562 tons, of which 123,893 tons were registered for foreign trade, 68,607 tons for coasting trade, and the remainder for fisheries. By 1795 the tonnage of the United States merchant fleet had increased to 747,965 tons, and in 1820, notwithstanding the oppressive influence of the embargo acts, to 1,280,167 tons, 583,657 tons of which were in foreign trade, compared with a tonnage for the entire British empire of 2,648,593 tons. Three years later the American tonnage (including repeated voyages) entering the United States from foreign ports, amounted to 810,761 tons, compared with 119,487 foreign, of which 89,553 tons were British.

In 1850 the new ships built by the United States amounted to 272,218 tons, while those built by Great Britain amounted to only 133,695 tons. These relative positions changed in the decade preceding the Civil War: in 1860 our new tonnage was 214,798, that of Great Britain 301,535 tons. In 1855, the year of greatest construction, the United States built 2,027 vessels, of an aggregate tonnage of 583,450, of which 381 were full-rigged ships. But, by 1859, in a steady and rapid decline, without equal in our marine history, the product of the yards in four years fell to 875 vessels, of 156,602 tons, of which only 89 were full-rigged ships. In 1860 the new tonnage rose to 214,798, the steam fleet aggregating 867,937 tons, of which 97,296 tons were registered against a total steam tonnage of only 500,144 for the entire British empire. The decline of 1859 was not to be attributed to the substitution of steam for sail, this country, as the home of Robert Fulton, easily taking and maintaining the first rank in the early years of steam navigation. But the substitution of iron for wood — the staple shipbuilding material of this country at the period — completely altered the conditions of shipbuilding in our own and competing merchant marines, and gave the advantage to Great Britain with its cheap production of iron and lower cost of labor.

Previous to the decline, however, these disadvantages, largely offset by the superior skill and energy of the Americans in the building and management of ships, were also modified by the United States government extending its fostering care over the maritime interests of the nation in the same manner that other governments did to theirs. And, while our government pursued this course, our shipbuilders were enabled to produce ocean steamers superior in speed and fully equal in any other respect to those built elsewhere, while rapid progress was being made toward assuming a position in ocean steam navigation equal to that held in the days of sailing vessels. But when, owing to internal troubles, the government's fostering care was withdrawn, while foreign governments adhered to the policy of granting pecuniary aid to establish steamship lines with other countries, then did the United States maritime trade begin to decline, until it was comparatively driven from the ocean, but few American-built steamers crossed the Atlantic, and rarely was the American commercial flag seen in any port in Europe.

During the Civil War a large amount of American shipping was sold to foreigners, and the capital thus released was invested in the building of railroads under a system of enormous land grants — really subsidies, which the country was ready to vote for its immediate advantage, but denied to the shipping interests. The subsidies which should be granted to our builders to create a mercantile navy superior to any are, instead, paid to foreign shipowners in the shape of freight money, to an amount variously estimated at from $90,000,000 to $110,000,000 per annum, the greater part peacefully absorbed by Great Britain.

Confederate cruisers almost annihilated the Union merchant marine during the Civil War, capturing and burning most of the ships which had not been sold or hastily transferred to foreign flags. In 1861 the merchant marine was registered at 5,539,813 tons, and it was not until 41 years later, in 1902, that this figure was passed with a total of 5,797,902 tons. In 1903 it had reached 24,425 vessels of 6,087,345 tons, including canal boats and barges; there being registered 12,836 sailing vessels of 1,965,924 tons, exclusive of canal boats and barges, and 8,054 steam vessels of 3,418,088 tons, distributed among the geographical divisions of the Atlantic, Gulf of Mexico, the Pacific, Northern Lakes, Western rivers, Porto Rico, and Hawaii. In the coasting trade the tonnage of vessels registered was 5,141,037, or 282,323 tons more than 1902, and in the foreign trade and whale fisheries 888,776 tons, an increase of 15,541 tons over 1902.

Since 1898, throughout the world there has been a period of extraordinary activity in shipbuilding, in which the yards of the United States have shared, their average annual output being approximately 400,000 gross tons. This revival is due principally to the construction of the new navy. In anticipation of a steady run of work on government ships, new plants, equipped with the most modern appliances, were laid down, available, of course, for merchant ships also. During 1901 we built 1,491 vessels of 468,831 gross tonnage. Of 1,000 tons and upward there were launched 16 merchant vessels from 2,036 to 12,760 tons each, 95,105 in all; 5 steel ferry, river, and bay steamers, of 5,479 tons; with 7 square-rigged vessels aggregating 12,336 tons, 21 wooden schooners of 36,122 tons, and 4 rigged barges of 7,359 tons; total seagoing vessels of 1,000 tons and over, 53, aggregating 156,431 tons. It is interesting to note that that of the Great Lakes exceeded it, amounting to 41 vessels of 158,631 tons, while in 1904 there was launched for service on the Great Lakes the steamer "Wolvin," 560 feet long, then described as the largest fresh-water ship in the world, but surpassed in 1905 by four other mammoth fresh-water steamers, each of over 12,000 tons, 569 feet long, 56 feet beam, and 31 feet depth; these four vessels alone representing a total carrying capacity equal to the entire fleet of the Great Lakes 25 years ago. At the beginning of the fiscal year 1902-3 there were under construction or contracted for in our yards 25 steel steamships of 1,000 tons and upward. For the transatlantic trade there were 7 large vessels of 76,960 tons; including two 600-foot ships for the Atlantic Transport Line of 13,400 tons; the Finland of 12,760 tons, for the International Navigation Company; the Missouri and Maine of 9,800 tons each, for the Atlantic Transport Line; and for the same line two vessels of 8,900 tons each. For the transpacific trade there were two immense vessels of

AMERICAN SHIPPING COMPANIES, 1905.

Name of Owners.	No. of Vessels.	Gross Tonnage.	Routes.
American-Hawaiian Co.	4	14,816	New York, San Francisco, Honolulu.
American Mail S.S. Co.	4	7,540	Boston, Philadelphia, Jamaica.
Atlantic & Caribbean Co.	5	6,207	New York, Porto Rico, Venezuela.
Boston & Philadelphia S.S. Co.	6	16,674	Boston, Philadelphia.
California Shipping Co.	16	28,851	Pacific Coast Ports.
Chapman, I. F., & Co.	6	11,125	Foreign Ports.
Clyde S.S. Co.	16	25,460	New York, Philadelphia, San Domingo.
Cromwell S.S. Co.	5	5,084	New York, New Orleans.
Empire Transit Co.	2	10,311	Foreign and Domestic Ports.
International Nav. Co.	12	64,573	New York, Southampton, Antwerp.
Mallory, Chas. H., & Co.	8	18,671	New York, Mobile, New Orleans.
Merchants' & Miners' Co.	9	14,437	Baltimore, Boston.
N. Y. & Cuba Mail S.S. Co.	17	38,771	New York, Havana, Mexican Ports.
Oceanic S.S. Co.	5	10,518	Honolulu, Australian Ports.
Old Dominion S.S. Co.	18	27,890	Baltimore, Boston.
Pacific Coast S.S. Co.	11	15,860	S. Francisco, Mexico, British Columbia.
Pacific Mail S.S. Co.	11	28,713	San Francisco, Panama, Hong Kong.
Sewall, A., & Co., Bath, Me.	15	32,342	Foreign Ports.
Southern Pacific Co.	17	41,658	New Orleans, Havana, Galveston.
Standard Oil Co.	3	9,080	European Ports.
U. S. & Porto Rico S.S. Co.	2	5,038	New York, Porto Rico.

20,000 tons each building at New London, Conn., for the Great Northern Steamship Company; same trade via Hawaii, the Siberia of 11,726 tons, for the Pacific Mail Company; Hawaii coasting trade, two of 8,600 tons each. For the Atlantic coasting trade there was a 9,000-ton vessel for the Standard Oil Company, a 6,250-ton for the New York & Texas Steamship Company, and a 5,252-ton ship for the Ocean Steamship Company; beside nine vessels from 1,000 to 4,577 tons.

Among notable modern passenger steamers, all steel, are the following:

The Kroonland, 12,760 tons, launched in 1901 (as was her sister the Finland); the largest ocean steamer ever built in America; constructed by the Cramps in Philadelphia for the International Navigation Company. Length over all, 580 feet; molded breadth, 60 feet; molded depth, 42 feet; displacement, 23,100 tons. Speed, 17 knots; engines, two triple-expansion, cylinders 32½, 54, and 89½ inches, 42-inch stroke; indicated horse-power, 10,200; boilers, 9 single-ended Scotch, 170 pounds pressure. Passenger capacity, 364 first class, 190 second class, 1,000 steerage.

The Korea, 11,276 tons, launched 1901; her sister, the Siberia, followed in 1902; they are largest and fastest steamers of any nationality running on the Pacific, the Korea the very fastest. They were built by the Newport News Shipbuilding Company for the Pacific Mail Steamship Company, and run between San Francisco, Japan, and China. Korea's average sea speed, 17.78 knots; on the trial trip she made the remarkable record of 18 to 19. Length over all, 572 feet 4 inches; molded depth, 41 feet 10 inches; displacement, 18,400 tons on 27-foot draft. Coal-bunker capacity, 2,600 tons; engines, twin quadruple-expansion, vertical inverted cylinders, 35, 50, 70, and 100 inches diameter, 66-inch stroke; boilers, 6 double and 2 single-ended Scotch, 200 pounds pressure. Passenger capacity, 210 first class, steerage 54 white and 1,144 Chinese.

The Sierra, built by the Cramps in 1900 for the Oceanic Steamship Company, one of three sister ships recently launched, to run from San Francisco to Honolulu (every 10 days), Samoa, Australia, and New Zealand (every three weeks), and Tahiti (every month). The Sierra is a very handsome twin-screw ship of 6,253 tons. Length, 400 feet; breadth, 50 feet 2 inches; molded depth to spar deck, 37 feet 2 inches. Engines, triple-expansion vertical, cylinders, 28, 46, and 75 inches diameter, 48-inch stroke; indicated horse-power, 8,000; speed, 17 knots; actual speed for the 7,200 miles from San Francisco to New Zealand, 15 knots. The three are constructed as auxiliary cruisers at need; with double bottom.

The Morro Castle, built by the Cramps in 1900 for the expanding West India trade; 6,004 tons gross; 8,280 displacement; length, 416 feet; breadth, 50 feet; molded depth, 36½ feet. She has a double bottom and seven steel bulkheads to the main deck. Engines, triple-expansion, 4-cylinder; cylinders, 32, 52, 60, and 60 inches diameter, 42-inch stroke; indicated horse-power, 8,000 at 170 pounds pressure. Sea speed, 17 knots. Passenger capacity, 104 first class, 60 intermediate, 44 second class. Crew, 117.

Other interesting facts are that the two largest cargo steamers ever built in America, the Shawmut and the Tremont, both of 9,606 tons, are plying regularly on their routes between Puget Sound, Japan, China, and Manila; that the Alaskan, of 8,716 tons, built at San Francisco, and now trading between Hawaii and the Atlantic coast, is the largest merchant steamer ever launched on the Pacific; while in river passenger boats a new vessel is being built in 1905 for service on the Hudson which surpasses in size, speed, and general equipment all hitherto constructed, the dimensions of the new boat being length, 400 feet, breadth, 82 feet, with accommodation for 5,000 passengers, and a speed of 23 miles an hour.

The year 1902 saw the consummation of a steamship combine, by which five of the largest transatlantic companies, the White Star, Dominion, Leyland, Atlantic Transport, and American Red Star, were merged into a single company with nearly 1,000,000 tons of shipping under its control. The combination was formed on strictly international lines, with a joint American and British control, the general manager of the line being an American with residence in this country. The organization was so arranged that the various companies included in the consolidation preserved their autonomy, and every consideration is shown their national and local surroundings. The combination was arranged to afford better transatlantic service at decreased cost, with more uniform rates, and a better distribution of traffic over the American and Canadian seaports. During the year 1902 both the largest vessel in the world and the fastest vessel at that time were launched, the Cedric, of 37,870 tons, about 1,000 tons larger than her sister ship the Celtic, and the Kaiser Wilhelm, with a sea speed of 24 knots. In size, although not in speed, these vessels were surpassed in 1905 by the steamship Amerika; length over all, 700 feet; breadth, 74 feet; depth, 53 feet; displacement, 42,000 tons; cargo capacity, 22,000 tons; built at Belfast, Ireland; while in 1906 will be launched the steamship Kaiserin Auguste Victoria, length over all, 705 feet; breadth, 77 feet; depth, 53.9 feet; built at Stettin, Germany. Innovations on these two steamers include elevator service between the five passenger decks, Turkish and electric baths, and modern à la carte restaurants.

Consult: Bates, 'American Navigation' (1902); Marvin 'American Navigation' (1902).

American Microscopical Society, an association organized for the purpose of promoting microscopical studies by granting aid to members from invested funds, and by publication. Office of secretary, University of Nebraska, Lincoln, Neb.

American Mines and Mining. The adoption of new methods in mining operations has been justified by an improved product, a reduced productive cost, or an increased rate of production. The introduction of machine methods in mining marked a revolution in this field of activity, and the history of mining since that time has been largely the history of the development of mining machinery. There is no more significant evidence of this fact than is to be found to-day in the coal mines of this country. In this work the unusual conditions have been met by the development of special types of machines.

Coal is to-day the most powerful factor in

the industrial life of the world. Its production is the most important industry of the age, and it alone has made possible the marvelous development of the 19th century. In point of value, coal exceeds the total production of all other minerals. It will be conceded that an industry which in a few years has overshadowed all others is one to which the best thought must have been given and the highest skill applied. While this is true in every department which pertains to the handling of the product from the miner to the consumer, there has not been until quite recently a corresponding advance in the actual mining of the coal over the crude and laborious methods which obtained 50 years ago.

The rapid advancement of the American mining industry, aided by modern and inexpensive handling and splendid transportation facilities, is appreciated when it is noted that out of the world's annual production of 50,000,000 tons of pig iron, the United States alone furnishes about 20,000,000 tons, which if made into telegraph wire one-fifth of an inch thick, would extend from the earth to the sun. The yearly valuation of this product of pig or cast-iron is more than $250,000,000, while nearly $50,000,000 are annually paid in wages to about 85,000 men and boys employed in its production.

Legitimate mining, conducted as a business on business principles, is more certain of large profit than any mercantile or industrial occupation. A retrospect of mining in the United States will show that where skill and economy have figured in mining operations, the result has been to create riches for companies and individuals, in many instances beyond the dreams of avarice. The foundations of states and prosperous cities have been laid by mining men, due principally to the enormous profits that legitimate mines of this country have paid. Government statistics show that American mining properly conducted is one of the safest investments for capital, besides possessing the attraction, speculative to an extent, that every ten feet of shaft or tunnel made in a meritorious mine is liable to strike a bonanza of still richer ore. American mining has progressively gone forward until the present annual output in the United States exceeds $1,000,000,000 in value. The minerals, including natural gas and petroleum, contributing to this aggregate are in great variety, and may be classed as follows: Antimony, asbestos, asphaltum and bituminous rock, barytes, bauxite, borax, buhrstones and millstones, cement, clay, coal—anthracite and bituminous, copper, corundum and emery, crystalline quartz, feldspar, flint, fluorspar, fullers' earth, garnet, gold, graphite, grindstones and pulpstones, gypsum, infusorial earth, tripoli and pumice, iron ore, lead ore, lithographic stone, limestones and dolomites, lithium ore, manganese ore, marble, marl, mica—sheet and scrap, mineral pigments, monazite, oilstones, whetstones and scythestones, ozocerite, phosphate rock, platinum and iridium, precious stones, quicksilver, sandstones and quartzites, silica sand, siliceous crystalline rocks, silver, slate, sulphur and pyrite, talc and soapstone, tungsten, uranium and vanadium, zinc ore, chrome ore, magnesite, molybdenum, nickel and cobalt, and rutile.

When mining was in its infancy, the methods of drawing were primitive and cruel. First it was done by women and girls, who were used as beasts of burden. Then came the car running on wooden stringers, which in time gave place to iron rails, and finally dogs, ponies, mules and horses were substituted for hand labor in hauling. As the mines became larger in output and more extensive in distance, the need of better methods became imperative. The next improvement was the tail and endless rope, which through long years of service has proved both reliable and economical. Sometimes the power engines are at the surface, and often underground, operated by compressed air. Then there is the steam locomotive, the electric motor, the air locomotive, and the gasoline motor, the latter still experimental. Of these steam is used to a very limited extent, as the legal and mining conditions which admit of its operation are rarely found. Electric power is now successfully applied to such operations as hoisting, hauling, drilling and cutting, as well as lighting and the driving of pumps and ventilating apparatus. Electric wires may be run anywhere and under any conditions to be found in a mine; they are easily and quickly laid, occupy small space, and may be readily tapped whenever it is desired to operate machinery. In contrast with other means of power transmission, electricity does not require many isolated boiler and engine plants, with long, inflexible and costly lines of piping, nor does it involve complicated and troublesome mechanism which is costly to attend and maintain, but it makes possible a considerable saving through the utilization of water-power or the consolidation of independent steam-power plants. See MINES AND MINING.

EDWARD S. FARROW,
Consulting Railroad and Mining Engineer.

American Museum of Natural History. See MUSEUM.

American Newspapers. The history of the printing of newspapers in America properly begins on 25 Sept. 1690, for it was upon that date that Richard Pierce, of Boston, issued the first number of what was to have been a periodical publication. Strange as it may seem, however, this first American journalist was endowed with a sense of originality of which even the makers of the modern sensational newspaper might find reason to be proud, for, in his salutatory, he stated that as there were many false rumors being circulated in the town of Boston which were constantly doing a great deal of harm, he requested his readers to furnish him with a list of those persons who were starting such stories that he might advertise them in the succeeding issues of his paper. In other words, his plan was to print a regular weekly list of all the liars in town, a scheme which would certainly have sold many copies of the sheet had not the authorities put an end to the project by promptly suppressing the newspaper. This journal was to have borne the name of 'Public Occurrences, both Foreign and Domestic.'

As only one issue of this strange newspaper appeared, the historians of journalism have usually failed to mention it, but, instead, have given the credit for the publication of the first periodical to John Campbell, a Scotchman, and the postmaster at Boston, who issued the first number of 'The Boston News-Letter,' on 24 April

1704. It was printed on half a sheet of pot paper, with a small pica type, folio, and its entire contents consisted of several extracts from 'The London Flying Post,' in relation to the pretender; the queen's speech to Parliament regarding that subject; a few items of local news; four short paragraphs of marine intelligence from New York, Philadelphia, and New London, and a single advertisement — that of the proprietor. This was just 82 years after the appearance of the first English newspaper in London, and 99 years after the first newspaper in France. Germany had antedated all other countries, having made several short-lived attempts to establish periodical journals as early as the latter part of the 16th century.

For more than 15 years Campbell had the journalistic field entirely to himself, but, in the latter part of 1719, another paper, called 'The Gazette,' was started in Boston, and, in 1721, a third was established by James Franklin under the name of 'The New England Currant.' In the meantime there had appeared at Philadelphia the first newspaper published outside of New England. It was called 'The American Weekly Mercury,' and its first number was issued by Andrew Bradford, the son of William Bradford, 22 Dec. 1719. The first paper to be printed in New York was 'The New York Gazette,' established in Oct. 1725, but by 1740, the number of newspapers in the English colonies in America had increased to 11, three of which had been established in Pennsylvania — one being printed in German — one in New York, one in Virginia, one in South Carolina, and the remaining five in Boston.

In the beginning the American newspaper was a very small affair, being little more than an abstract of such papers as might chance to arrive from Europe on or about the date of publication. In fact, little change was made in them until after the time of the Revolution when the political agitators found it convenient to make use of them in presenting their appeals to the people. It was largely for this purpose that the first daily newspaper, 'The American Daily Advertiser,' was established in Philadelphia by Benjamin Franklin Bache, in 1774. During the time that the seat of government was at Philadelphia, it was this paper that was used by Jefferson to oppose the Federal section of Washington's administration as well as all measures which originated with Hamilton or his friends. In 1802, Zachariah Poulson became its proprietor, and the name which he gave to it, 'Poulson's Advertiser,' was retained until 1839, when it was consolidated with 'The North American.'

The second daily newspaper was 'The New York Daily Advertiser,' first issued on 1 Mar. 1785, by Francis Childs & Company. About a year later, 29 July 1786, the first newspaper appeared west of the Alleghany mountains. It was published at Pittsburg, Pa., and was called 'The Gazette.' During the early post-Revolutionary days, Alexander Hamilton's special organ was 'The United States Gazette,' a paper established in New York in 1789, by John Fenno, of Boston.

The territory comprised within the New England States had no permanent daily newspaper until 3 Mar. 1813, when the Boston 'Daily Advertiser' was started by William W. Clapp. Prior to that time two distinct attempts to establish such papers had been made. As early as 6 Oct. 1796, Alexander Martin, an Irishman, started 'The Polar Star,' which lived about six months. It was followed, 1 Jan. 1798, by Caleb P. Wayne's 'Federal Gazette,' which ceased publication in less than three months. Of the hundreds of papers started in New York between 1725 and 1827, when the first number of 'The Journal of Commerce' appeared, only two now survive, 'The Commercial Advertiser,' now better known as 'The Globe and Commercial Advertiser,' and 'The Evening Post.'

The history of the penny newspaper dates from 1830, the idea having been suggested by the 'Illustrated Penny Magazine,' first issued in London during that year. During the next few years, therefore, several similar attempts to introduce cheap papers were made in the United States, notably at Philadelphia and Boston. As these publications were always as small as they were cheap, however, they were but short-lived, and it was not until 1 Jan. 1833, when the price of 'The Morning Post,' was reduced to one cent by its publishers, Dr. Shepard, Horace Greeley, and Francis V. Story, that any pretentious effort was made to print a cheap newspaper. Although this experiment was not a success its failure was due to causes other than that of the price, so, when Benjamin H. Day established the New York 'Sun,' 3 September of the same year, he also fixed its price at one cent, and the day of the cheap press had come.

During the time which elapsed between the beginning of the 19th century and the year 1833 American journalism passed through two of the most important transition periods in its history. After having served its purpose as the mouthpiece of more or less patriotic agitators, it entered upon a period of party conflict, which, while fierce enough, was not always directed along judicious lines. Edited by adventurers, often brilliant men whose flashing wit attracted widespread attention to their utterances, this was the time in which the purpose of the American press could in no sense be depended upon. It was not until 1815, or a little later, that the newspapers of the country became pretty thoroughly emancipated from the control of these politicians. It was still more a political tract than anything else, however; it was narrow in its field and intolerant in its expressions, but

DEVELOPMENT OF AMERICAN JOURNALISM FROM 1775 TO 1905.

Year	Daily	Weekly	Semi-Weekly	Monthly	Semi-Monthly	Quarterly	Total
1775	......	....	....	......	......	....	37
1800	......	....	....	......	......	....	150
1810	[illegible]	282	[illegible]	*[illegible]	......	....	361
1828	......	....	....	......	......	....	861
1840	......	....	....	......	......	....	1,403
1850 (U S)	254	1,902	31	100	95	[illegible]	2,526
1860 (U S)	387	3,173	[illegible]	280	......	[illegible]	4,051
1870 (U S)	574	4,295	115	622	96	[illegible]	5,871
1880 (U S)	[illegible]	8,633	133	1,167	160	[illegible]	11,314
1880 (A)	909	7,811	134	929	110	[illegible]	10,100
1885 (A)	[illegible]	10,241	[illegible]	[illegible]	189	[illegible]	13,304
1890 (A)	1,662	13,562	[illegible]	[illegible]	260	[illegible]	17,712
1895 (A)	1,988	15,106	[illegible]	2,150	249	[illegible]	20,217
1900 (A)	[illegible]	15,681	[illegible]	2,328	261	[illegible]	[illegible]
[illegible] (A)	2,377	[illegible]	[illegible]	[illegible]	262	[illegible]	[illegible]

(A) Ayer's American Newspaper Annual.
*Tri-weekly.

still, at the same time, its utterances were delivered with freedom and courage. It was not until 1833 that the first real newspaper appeared. This was the New York 'Sun,' and the success of its policy of publishing the news instead of devoting its columns to the editor's personal and often eccentric opinions upon political matters was so immediate that it was soon followed by many rivals. Thus commenced the last and greatest period in the development of the American press.

STATISTICS OF AMERICAN NEWSPAPERS
(Taken from Ayer's American Newspaper Annual for 1905)

State or Territory.	Daily	Weekly	Semi-Weekly	Monthly	Semi-Monthly	Quarterly	Total
Alabama	23	198	2	12	8	1	245
Alaska	3	9	2	......	....	....	14
Arizona	15	43	....	3	....	....	61
Arkansas	29	245	6	10	2	....	292
California	127	474	24	92	16	3	736
Colorado	38	286	5	35	6	1	372
Connecticut	37	97	10	19	....	4	171
Delaware	4	27	1	3	....	....	35
District of Columbia	3	24	....	34	1	3	66
Florida	19	136	4	12	2	....	173
Georgia	24	271	10	38	7	1	355
Hawaii	8	18	3	8	....	....	39
Idaho	7	96	6	1	....	....	111
Illinois	182	1,185	41	267	24	13	1,721
Indiana	156	582	29	59	6	2	838
Indian Territory	12	174	4	3	....	....	193
Iowa	69	889	52	91	8	1	1,119
Kansas	65	632	9	30	3	2	742
Kentucky	30	235	17	24	4	3	314
Louisiana	24	165	5	13	4	....	212
Maine	17	98	4	35	2	1	158
Maryland	17	140	3	27	3	5	198
Massachusetts	81	413	7	142	10	26	600
Michigan	86	586	26	79	8	3	792
Minnesota	46	662	6	61	16	....	793
Mississippi	14	207	5	9	7	....	242
Missouri	84	775	16	125	7	8	1,021
Montana	11	79	7	6	1	....	104
Nebraska	28	537	15	35	1	....	641
Nevada	8	24	3	......	....	....	35
New Hampshire	17	128	1	11	1	....	159
New Jersey	56	280	4	26	2	2	371
New Mexico	6	63	1	3	....	....	73
New York	210	1,069	51	574	16	36	2,0[illegible]7
North Carolina	32	182	20	17	8	1	263
North Dakota	8	246	2	6	1	....	263
Ohio	174	771	42	133	15	16	1,166
Oklahoma	28	295	....	11	2	....	337
Oregon	23	170	14	17	3	....	227
Pennsylvania	214	910	44	234	9	23	1,436
Philippine Islands	12	8	2	1	1	....	32
Porto Rico	10	9	1	3	....	....	24
Rhode Island	14	39	3	1	7	....	66
South Carolina	13	114	15	9	2	....	156
South Dakota	15	281	4	16	2	....	319
Tennessee	17	242	3	34	5	17	322
Texas	86	705	18	47	7	3	8[illegible]5
Utah	9	56	6	9	3	....	84
Vermont	10	84	....	8	1	1	105
Virginia	30	163	8	32	4	4	246
Washington	23	226	5	31	3	....	288
West Virginia	35	173	5	......	10	....	225
Wisconsin	64	571	23	55	2	....	720
Wyoming	4	40	6	......	2	....	52
Totals	2,377	16,152	600	2,550	262	[illegible]	22,[illegible]12

No reliable statistics of newspapers were kept prior to 1810, at which time there were 366 publications of all classes in the United States. None of these publications appeared west of the Mississippi River, and only 25 of them were published daily. It is interesting to compare the number of newspapers published at that time with those issued in 1905. (The American Newspaper annual gives the preceding tables) The comparison is given in the tables at the top of the next column:

	Total	Daily	Semi-Weekly	Tri-Weekly	Weekly
1810	366	25	36	15	2[illegible]
1905	23,558	2,457	634	50	16,9[illegible]5

From reliable sources the following list of newspapers, which were started prior to or during the year 1800 and which are still in existence, was compiled:

MAINE.		
Portland	Advertiser	1785
NEW HAMPSHIRE.		
Keene	New Hampshire Sentinel	1799
	Cheshire Republican	1793
Portsmouth	New Hampshire Gazette	1756
	Journal	1793
VERMONT.		
Rutland	Herald	1794
Windsor	Vermont Journal	1783
MASSACHUSETTS.		
Greenfield	Gazette and Courier	1792
Haverhill	Gazette	1795
Newburyport	Herald (weekly)	1793
Northampton	Hampshire Gazette (weekly)	1786
Pittsfield	Berkshire County Eagle (weekly)	1789
	Sun	1800
Salem	Gazette and Mercury	1768
	Register	1800
Worcester	Spy	1770
RHODE ISLAND.		
Newport	Mercury	1758
CONNECTICUT.		
Bridgeport	Republican Farmer	1790
Hartford	Courant	1764
New Haven	Connecticut Herald and Journal	1766
Norwalk	Gazette	1800
Norwich	Courier	1796
NEW YORK.		
Ballston Spa	Journal	1798
Cambridge	Washington County Post	1798
Catskill	Recorder	1792
Hudson	Gazette	1785
Newburg	Register	1796
Owego	Gazette	1800
Troy	Northern Budget	1797
Utica	Herald and Gazette	1793
N. Y. City	Commercial Advertiser	1797
	Shipping and Commercial List and New York Prices-Current	1795
NEW JERSEY.		
Newark	Sentinel of Freedom	1796
New Brunswick	Times	1792
Trenton	State Gazette	1792
PENNSYLVANIA.		
Chambersburg	Franklin Repository	1790
Gettysburg	Star and Sentinel	1800
Greensburg	Westmoreland Democrat	1798
Lancaster	Intelligencer	1794
Norristown	Herald	1799
Philadelphia	North American	1784
Pittsburg	Commercial Gazette	1786
Reading	Adler (German)	1796
York	Gazette	1796
DELAWARE.		
Wilmington	Delaware Gazette and State Journal	1784
MARYLAND.		
Annapolis	Maryland Gazette	1745
Baltimore	America	17[illegible]3
VIRGINIA.		
Alexandria	Alexandria Gazette	1784
GEORGIA.		
Augusta	Chronicle	1785
OHIO.		
Cincinnati	Commercial Gazette	1793

In point of age the following are the ten oldest newspapers in the United States:

1. Annapolis, Md., Maryland Gazette 1745
2. Portsmouth, N. H., New Hampshire Gazette 1756
3. Newport, R. I., Mercury 1758
4. Hartford, Conn., Courant 1764
5. New Haven, Conn., Connecticut Herald and Journal 1766
6. Salem, Mass., Gazette and Mercury 1768
7. Worcester, Mass., Spy 1770

8. Baltimore, Md., America 1773
9. Windsor, Vt., Vermont Journal 1783
10. Alexandria, Va., Alexandria Gazette 1784

Prior to 1810 the circulation of the most widely read daily newspaper did not exceed 900 copies, while there were few publications, either weeklies or semi-weeklies, that could boast of a larger circulation than that of 600 copies. Supposing that there were 25 dailies in 1810, issuing 310 times a year; 36 semi-weeklies; seven tri-weeklies, and 290 weeklies, each with a circulation of about 600 copies, the aggregate circulation for the year would have been considerably less than 2,000,000 copies, while the value of the paper used could not have been in excess of $125,000. Compare those figures, therefore, with these from the United States census report for 1900, when the total sum invested in the newspaper and periodical publications of the country was stated to be $192,443,708; when there were 94,604 persons employed in this business, their total wages for the year amounting to $50,333,051, and when the total value of the newspapers and periodicals produced was fixed at $222,893,569. During the year 1900, no less than 956,335,921 pounds of paper were used by the newspapers in producing their aggregate circulation of 8,168,148,749. The cost of this paper was $22,197,060. During this year the amount received from advertising was $95,861,127, while the amount from subscriptions and sales was $79,928,483. Enormous as these figures may seem, however, they are now far too low, for the five years that have elapsed since the last census was taken has been a period of wonderful growth in every branch of the newspaper field. The following table is interesting as showing the steady development in number and circulation of the industry of daily paper making in America:

Year	Number of Daily Papers Published	Total Circulation Per Issue
1850	254	758,454
1860	387	1,478,435
1870	574	2,601,547
1880	971	3,566,395
1890	1,610	8,387,188
1900	2,235	15,102,156

To attempt to tell the story of the growth of the American newspaper without relating some particulars in regard to the wonderful feats which it has from time to time performed would be to give but a superficial view of the subject. Prior to the days of the telegraph the daily press had great difficulty in obtaining its information about current events in other parts of the country. To offset this disadvantage they adopted three methods of quick communication. One was by pony express; another was by carrier pigeons, and, when steam had been sufficiently developed to make fast travelling by rail or steamboat possible, special trains and boats were frequently chartered for special occasions. The New York 'Herald' and the New York 'Journal of Commerce' were the first papers to own swift sailing yachts which were used to obtain early information from incoming European vessels, while A. S. Abell, of the Baltimore 'Sun,' established his own overland express between New Orleans and Baltimore. This consisted of 60 blooded horses, housed at conveniently located relay stations, and the project was so successful that, during the Mexican War, he not only beat all the other newspapers in getting news, but he secured his information so far ahead of the government's own despatches, that he was able to advise the officials at Washington of important events, sometimes more than 30 hours before the reports of the happenings had been received at the War Office. Another instance of conspicuous enterprise was shown by Henry J. Raymond. While a reporter for the New York 'Tribune,' he was sent to Boston to report a notable speech by Daniel Webster. Returning by boat, he arranged to have the necessary composition frames and cases erected in his room, that, as fast as he could write, the sheets might be put into type, so that all were ready for publication the instant he reached the office.

In 1846, when the entire country was so greatly excited over the Oregon boundary dispute with Great Britain, several of the newspapers combined to send a swift pilot boat to England. There all the important news was obtained; the boat returned as quickly as it went, and the American people were provided with the information they craved many days before it could possibly have arrived if it had come by the ordinary channels, the slow-sailing vessels of that day.

As so much enterprise was shown by newspaper publishers at a time when the means of quick communication were few and costly, it was but natural that they should have hailed the steam railroad and the electric telegraph with delight. During the 10 years between 1840 and 1850, the period in which these inventions were first generally extended, the circulation of the American papers increased more than two-fold. In fact, they seized upon the telegraph with such avidity, that, to overcome the inconvenience and delay caused by the manner in which they were crowding one another, the press associations were formed, in 1850. By means of these associations the ordinary news which occurred in the populous parts of the country was sent, practically in duplicate, to all the papers subscribing to the service, and individual papers were compelled to rely upon special correspondents only for reports of such important events as they might desire to "cover" with more attention to detail. It was the same story in the latter sixties, when the cable had been laid, for it was this invention that made it possible for papers in the United States to obtain long reports of the progress of the Franco-Prussian War of 1870. Although the revision of the New Testament was completed at a time when cable rates were still very high, W. W. Story, of the Chicago 'Times,' ordered that 8,000 words of the new version should be cabled to his paper, and, when the complete work arrived at New York on the steamer, it was telegraphed to him in its entirety, 21 wires being used for that purpose.

Owing to the high rates at first charged for telegraph and cable messages the papers of those days did not get the almost unlimited news service which they receive to-day. Even as late as 1879 the night rate from California to Boston was 10 cents a word; between Chicago and Boston it was five cents a word, and between Washington and Boston, two cents a word. Since

that time the rates have been reduced fully 66 per cent, while the tolls paid by press associations is now about 14 cents per hundred words, irrespective of the number of papers to which the despatches are delivered. The original cable rate was $100 for 20 words, whether served to newspapers or to the general public, while the rate to newspapers is now but 10 cents a word, either for day or night service.

The result of the high tolls was shown in the compact despatches published by the newspapers of that day. For example, when the America won the international yacht race, 22 Aug. 1851, no report of the event was received by any American paper until 4 September, when the news came in the form of a despatch from Halifax. On this day the report in the New York 'Sun' contained about 500 words, the 'Tribune' used but 250 words about the contest, and the 'Evening Post' was content with 200 words. So, too, when Brooks assaulted Sumner, the Senator from Masachusetts, in 1854, the longest report sent to any Boston paper comprised less than half a column, and this was printed quite inconspicuously at the bottom of the page. In 1860, when Lincoln was nominated for the Presidency, at Chicago, one operator was able to send out all the press matter that was offered to him, while, at recent conventions, the hundred and more operators have had all they could do to handle the millions of words of descriptive matter filed with them by correspondents representing every newspaper of prominence in the country. When these facts are remembered, however, it does not seem so strange that the aggregate number of words of press matter that went over the Western Union wires in 1879 was but 28,000,000, whereas the total number of words contained in press specials handled by the same company in recent years has been no less than 10 times as great.

At the same time there was some excuse for the lack of interest displayed in news events. Those were the days of small and compact papers and even the best printing plants of that time would have been utterly unable to cope with such an avalanche of news as that which daily floods the modern newspaper office. At that day stereotyping had not been discovered, presses were slow, and hand-composition was the only method known to the trade. As papers were printed directly from the type, and as even the Hoe lightning steam-presses, patented in 1847, had a capacity which seems exceedingly slow when compared to that of presses to-day, newspapers with large circulation were compelled to go to press much earlier than their less popular rivals, a fact which placed them at great disadvantage in obtaining late news. The facilities for the distribution of papers were also few and inadequate, even for those days. Scarcely more than 40 years ago some of the most progressive journals in this country depended solely upon boys to carry their papers to their subscribers, while larger lots, the papers intended for dealers, were trundled through the streets on wheelbarrows. To-day all the newspapers have their own systems of fast delivery wagons, and the most progressive publishers charter "special" trains, not only for their Sunday editions, but frequently for other occasions during the year.

The first paper to begin the work of stereotyping its pages was the New York 'Tribune. This was in 1861. Four years later the Bullock perfecting press, made in Philadelphia, made it possible to print a paper from plates, both sides at the same time, at a rate of from 6,000 to 10,000 an hour. The R. Hoe & Company perfecting press appeared in 1871. This printed from 10,000 to 12,000 eight-page papers an hour, and it was quickly followed by the other Hoe inventions, the double press, the quadruple press, and, finally, the sextuple, with its working capacity of from 60,000 to 75,000 eight-page papers an hour, and with attachments capable of printing from 4 to 64 pages. The latest inventions are the color presses, made both by Hoe and by Scott, by means of which papers may be printed in several colors at once. As the result, every up-to-date newspaper office is now equipped with facilities for printing in almost every hue of the rainbow, although it is only within the last quarter of a century that publishers have attempted to use illustrations of any kind. During the late seventies an attempt was made to establish an illustrated daily, but the publication had but a brief existence. From that day illustrated journalism was practically unknown in America for many years. It was more than 20 years ago when the wood-cut was the only form of illustration adapted to newspaper uses, and as it required two or three days to make each wood-cut they were not available at short notice. Now, however, with all our facilities for almost instantaneous illustration it is no rare thing to find midnight happenings graphically pictured in the morning editions of the daily newspapers.

The invention of type-setting machines is another innovation that has an almost incalculable effect in the development of the modern newspaper. By the use of such a machine one operator is capable of performing as much work as three men could formerly do by the old method of hand composition. Some of these machines make a new cast of type each day, and all of them represent a marked increase of product at a great reduction in cost.

The growth of the Sunday newspaper dates from the Civil War, but it was many years after the conclusion of that struggle before the large Sunday editions began to make their appearance. In fact, it was less than 35 years ago that one of the leading papers in Boston increased the size of its Sunday issue from four to eight pages, and, strangely enough, the change met with all kinds of adverse criticism. During the next few days many of the subscribers to this journal called at the office to protest that the new paper was much too large, and this same criticism has continued as the great Sunday papers have steadily increased in size. In spite of the protests of these indignant critics, however, the fact remains that the American newspaper has simply kept pace with the development of the country. With greater facilities for news gathering, and with modern methods of distribution, the circulation of the prominent newspapers has increased to a degree that would once have been considered beyond all bounds of possibility. So, too, is this true in regard to advertising. Whereas, in 1810, the total amount of advertising printed in all the papers in the United States could scarcely have exceeded a few hundred thousand dollars, the in-

come from such sources to-day is now in excess of $100,000,000 per annum. To print all the news that the modern newspaper is required to print, to give space to all the features and special articles that the public has come to demand, and to find room for all these columns upon columns of advertisments, is certainly beyond the scope of any small, compact sheet. If it is true, as its friends claim, that the newspaper is one of the great sources of education in this country, upon what does this reputation rest? Certainly not upon its news alone, for the papers of every land describe the important happenings of the day. No, it is these special features, the articles descriptive of travel and of all the progress of the world in every field of human endeavor — in other words, the "magazine" articles that have now found wider circulation through the columns of the daily newspaper — that have made these organs what they now are, a great educational factor which has exerted more influence upon the development of the intelligence of the American people than it would be possible to estimate. Whatever the critics may think or say, therefore, one cannot deny the fact that newspapers are big to-day for the simple reason that they are required by the public, and those who are best acquainted with the journalistic situation find that every indication points to larger rather than to smaller papers. Great as this country is, it has by no means reached the end of its development, and, as it grows in population, and expands commercially, the demands upon the newspapers will necessitate a corresponding growth in this product of American industry.

Charles H. Taylor,
Editor 'Boston Globe.'

American Notes, a work by Charles Dickens, published in 1842 and embodying his impressions of the United States.

American Numismatic and Archæological Society, an association organized 1858, incorporated 1865. Its objects are the collection and preservation of coins and medals, the investigation of matters connected therewith, and the popularization of the science of numismatology; also the collection, examination, and elucidation of the antiquities of this and other countries. Membership about 300. See Numismatics.

American Oriental Society, an association organized in 1842 for the promotion of Oriental scholarship. All its publications are in the semi-annual journal of the society (cited as "Jaos"), which for 60 years has been an authority on Oriental subjects and in which appear monographs and special articles of all sorts relating to the Orient. The society has numbered among its presidents some of the most distinguished scholars of the country — Hadley, Woolsey, Whitney, etc., and from its inception has been a medium of communication between the East and the West. In age it outranks the German Oriental Society and all others except the Royal Asiatic Society of England. Membership, 350.

American Ornithologists Union, an association organized in 1883 for the advancement of its members in the science of ornithology. Membership, 825. It issues a quarterly magazine, 'The Auk.' See Ornithology.

American Party, the name of three separate political organizations in the United States.

1. The only one of great importance, usually styled "Know-Nothings." The genesis of this party lay deep in the nature of American settlement and history. The Constitution crystallized political parties definitely into Federalists and Anti-Federalists: the one upholding firm government on the general European model, with the local aristocracies in the ascendant; the other desiring the least possible government of any sort, and no upper-class ascendancy. Immigrants who had left Europe because of too free indulgence in freedom of speech, thought, and action, allied themselves with the Anti-Federalists, which led the incensed Federalists, on gaining power in 1795, to raise the term for naturalization from two to five years, and in 1798 to 14 years, besides passing the Alien and Sedition Laws (q.v.). The Republicans, coming into power with Jefferson in 1801, in 1802 repealed the obnoxious acts and restored the term to five, swelling their ranks for years with a relay of acrid foreign democrats. Six members of the Congress which declared the War of 1812 against Great Britain were members of the Society of United Irishmen; and the Federalist Hartford Convention of 1814 brought forward a provision against aliens holding office. Quiescent for many years, the movement revived (1835) in New York city, where a compact and clannish foreign body of immigrants, avid of office and openly allying themselves as foreigners against the natives, was accumulating; one procession bore a transparency lettered "Americans shan't rule us." The religious question was also then, as since, a formidable factor in the trouble. In 1843 the Democrats carried the city by a close vote, and distributed the majority of the offices to foreigners, with the result that in the November election for State Senator an "American Republican" candidate polled nearly a fourth of the vote, and the next spring a "Native American" candidate defeated the Democrat by 4,000, and the regular Whig party nearly vanished in the city. The excitement spread to New Jersey and Philadelphia; riots between natives and foreigners cost some lives and much property, including two Catholic churches. The Whigs voted with the Native party to secure its vote for Clay; but finding that it resulted in Native local officials and Democratic presidential majorities, drew off, and by 1847 the Native party had pretty much disappeared. Clay in 1844 had six Native American electoral votes, four from New York and two from Pennsylvania; and for some years the Middle States cast small votes for the party.

A new birth came to it about 1852. The Fugitive Slave Law of 1850 had largely dissolved and recombined both Whig and Democratic parties, and those of the former who wanted the *status quo* on slavery without public agitation cast about for a new issue to keep their organization together. The Native American issue was temptingly at hand, and indeed had never ceased to be a sore in the Whig mind. The tremendous flood of foreign immigration set going in part by the Irish famine of 1847, in part by the revolutionary movements of 1848–50 on the Continent, had kept a steady stream of reinforcements pouring into the Democratic party which almost swamped the

Whigs and made it quite impossible to win elections except by fusions that sacrificed all political principle or consistency; they felt it a genuine wrong to the native or long-resident classes, and there was nothing in the use to which the other party put their victories to make them feel otherwise. They now developed a secret oath-bound society whose real name was "Sons of '76, or Order of the Star-Spangled Banner"; but its name or precise object (of course they knew its general aim) was not revealed to members till the "lodges," which they instituted in imitation of the Masons, had raised them to the higher degrees. Hence their stock answer to questions concerning it was "I don't know," which became the popular motto of the order and gave them the nickname of "Know-Nothings." The evils it "viewed with alarm" were the increasing power of the Roman Catholic Church, the vast sudden flood of immigration which was taking the control of the United States out of the hands of its citizens, and the greed of foreigners for office which greatly multiplied the danger from their actual number. Its motto, or at least the essence of its principles, was "Americans must rule America,"— doubtless with a reminiscence of the foreign motto before mentioned; and the countersign at its lodges was an order said to have been issued by Washington at some unspecified occasion, "Put none but Americans on guard tonight." It acted in politics, not by putting up separate tickets, which would have kept tally on it and given the other parties a clear target and open victory, but by indorsing selected candidates of the others in secret convention of delegates from lodges, at which every member must vote or be expelled. This could not be known till election, and hence made havoc of all political calculations and left the workers beating the air. The Kansas-Nebraska Bill, which extinguished the Whig and created the present Republican party, and made the slavery issue one of life or death, drove into the Know-Nothing party a vast number of the moderate section not yet ready to oppose the South; it now took or was given the name of the American party, and came into the open field. In 1854 it carried Massachusetts and Delaware and polled over 120,000 votes in New York State. Thus far it had been almost wholly a Northern party; but in 1855 it made deep inroads in the South as well, where foreigners were few and the issue was locally innocuous. In that year it elected the governors and legislatures of New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Kentucky, and California; the controller and legislature of Maryland and the land commissioner of Texas; and narrowly missed carrying the legislature of the latter, and those of Virginia, Georgia, Alabama, Mississippi, and Louisiana. But even at this time, when it was sweeping all before it, and the conservatives of both parties were crowding into it panic-stricken to avoid the real issues hurrying the country to the precipice, keen observers saw its hollow ephemerality: Horace Greeley of the New York *Tribune* said that "it contained about as much of the elements of permanence as an anti-cholera or an anti-potato-rot society." With 1856 it came into the national field, and for slavery tried to substitute terrific visions of a revival of the terrors of the Inquisition; denounced Archbishop Bedini, the papal nuncio, as an emissary of diabolic designs; and forced public discussions in which all the misdeeds of the mediæval Christian Church before and after 1520 were recounted. February 1856 a national nominating convention was held at Philadelphia; and its outcome, to the disgust of the majority, turned on slavery after all. A secret "grand council" held a session 19–21 February to draft a platform; and after three days of violent contention reported as part of it this curious "straddle," in later political slang: That all public offices should be given to native-born citizens, and the term before naturalization be 21 years; that "all laws" (that is, the Fugitive Slave Law) should be enforced till repealed or declared unconstitutional; that Pierce's administration be reprobated for repealing the Missouri Compromise; and that State councils be recommended to drop their "degrees" and substitute a pledge of honor from members,— that is, that it cease to be a secret terror to other parties and be one itself. But this meant death, as did its absurd attempt to gain Northern votes by opposing the Kansas-Nebraska Bill, and Southern votes by upholding the Fugitive Slave Law. In the open convention of 22 February, 50 Northern delegates offered a resolution that the secret grand council could not bind the convention by a platform; and on its rejection withdrew. The convention then nominated Millard Fillmore of New York for President, and Andrew Jackson Donelson of Tennessee for Vice-President; and the Whig national convention later adopted the nominations, but made no reference to the platform. In the spring of 1856 the party still increased its power, there being only local issues at stake; New Hampshire and Rhode Island elected "American" governors, making eight of the 32 States in their hands. But the presidential election showed what a phantom the party was: Fillmore gained the electoral vote of but one State, Maryland, with eight electors; the popular vote was 874,534 out of a total of 4,053,967; and in New Hampshire it sank from 32,119 for governor in spring to 422 in face of the real issue. It elected 15 or 20 Congressmen, carried Rhode Island and Maryland State elections in 1857, and in the Senate of December had five members. In the Congress of 1859 it had become a Border State party, with one Senator from Kentucky and one from Maryland, and 23 Congressmen,— three from Maryland, five from Kentucky, seven from Tennessee, one from Virginia, four from North Carolina, two from Georgia, and one from Louisiana. In the campaign of 1860 its members largely made up the Constitutional Union (Bell-Everett) party, which tried to avert the war. The party was by no means without its use: it brought forward many strong leaders who did good service in the real parties when the issues had shown themselves inevitable.

2. A party directly adverse to the first in being founded on opposition to secret societies: organized by the National Christian Association at the adjournment of its convention at Oberlin, Ohio, in 1872. Organization was completed and the name adopted at a convention in Syracuse, N. Y., in 1874. At Pittsburg, 9 June 1875, a platform was adopted demanding recognition of the Sabbath, introduction of the Bible into public schools, prohibition of the sale of liquors, withdrawal of the charters of secret

societies and prohibition of their oaths, international arbitration, restriction of land monopolies, resumption of specie payments, justice to the Indians, and direct popular vote for President and Vice-President. James B. Walker of Illinois was nominated for President. In 1880 it again made nominations; in 1884 S. C. Pomeroy was nominated, but withdrew in favor of John P. St. John, the Prohibition candidate.

3. A party organized at a convention in Philadelphia, 16–17 Sept. 1887. Its platform demanded a 14-years' residence for naturalization; exclusion of anarchists, socialists, and other dangerous characters; free schools; the building of a strong navy and coast fortifications, and internal improvements; prohibition of alien proprietorship; permanent separation of church and state; and enforcement of the Monroe Doctrine.

FORREST MORGAN,
Connecticut Historical Society.

American Patriotic Societies. See PATRIOTIC SOCIETIES.

American Philological Association, a society inaugurated by William D. Whitney, of Yale, at Poughkeepsie, 1869 as an outgrowth of the Oriental Society, Classical Section. Its object is the same as that of the British Philological Society (q.v.); it publishes an annual volume of 'Transactions' and also 'Proceedings,' detailing its meetings and giving titles of papers presented. It has a membership of some 600.

American Philosophical Society, The, is the oldest scientific society in America. Benjamin Franklin, in his 'Autobiography,' states that in the year 1727 «I united the majority of well-informed persons of my acquaintance into a club which we called the Junto, the object of which was to improve our understandings.» As the population of the colonies grew, Franklin saw the need of a society of larger scope and usefulness than the Junto; therefore, in 1734, he issued a circular, entitled 'A proposal for promoting useful knowledge among the British plantations in America,' in which he urged «that one society be formed of virtuosi or ingenious men residing in the several colonies, to be called The American Philosophical Society, who are to maintain a constant correspondence. That Philadelphia, being the city nearest the centre of the colonies, communicating with all of them northward and southward by post, and with all the islands by sea, and having the advantage of a good, growing library, be the centre of the society.»

The proposition was favorably received, and in the following spring Dr. Franklin wrote to Gov. Cadwallader Colden, of New York, that the Society «is actually formed and has had several meetings to mutual satisfaction.» He gave a list of the members, and added that «there are a number of others in Virginia, Maryland, Carolina, and the New England colonies who we expect to join us as soon as they are acquainted that the Society has begun to form itself.»

In January 1769 this society united with another which had been subsequently formed in Philadelphia with a similar object, and entitled «The American Society held at Philadelphia for promoting Useful Knowledge,» and the consolidated societies took the fused name of «The American Philosophical Society held at Philadelphia for Promoting Useful Knowledge,» and elected Benjamin Franklin its first president, and he held this office by successive annual reëlections until his death in 1790.

The Society at once entered upon arrangements to carry out a notable scientific undertaking of great magnitude for those days, namely, to make observations of the expected transit of Venus in the following June — a rare phenomenon which had not occurred for 130 years and would not recur for 105 years. It erected three temporary observatories and appointed a committee, of which David Rittenhouse was the head, to have charge of the observations on the day of the eclipse. The weather in northern Europe was cloudy, but in the neighborhood of Philadelphia it was perfectly clear, and a high European authority has said that «the first approximately accurate results in the measurement of the spheres were given to the world, not by the schooled and salaried astronomers who watched from the magnificent royal observatories of Europe, but by unpaid amateurs and devotees to science in the youthful province of Pennsylvania.» The results of these observations were printed in the first volume of the Society's 'Transactions,' which was published in quarto form in 1771. The publication of the quarto 'Transactions' still continues, and in addition the Society publishes 'Proceedings' in octavo form.

Franklin was succeeded in the presidency by David Rittenhouse, the eminent astronomer, who held the office for five and a half years, until his death in 1796, and he in turn was succeeded by Thomas Jefferson, who held the office until 1815, including the eight years of his incumbency of the Presidency of the United States. «The tranquil pursuits of science,» he wrote, were his «supreme delight,» and the most exciting political duties could never withdraw him from them. Jefferson was succeeded in the presidency by Dr. Caspar Wistar, the eminent anatomist, and subsequent incumbents were Dr. Robert Patterson, Chief Justice Tilghman, Peters S. Du Ponceau, Robert M. Patterson, Dr. Nathaniel Chapman, Dr. Franklin Bache, Prof. Alexander Dallas Bache, Judge Kane, Dr. George B. Wood, Frederick Fraley, and Edgar F. Smith.

The membership of the Society since its foundation has included names distinguished in science on both continents. The number of members who may be elected in any one year is limited to 15 residents of the United States and 5 foreign residents. The election of members is held during the general meeting in April of each year. The ordinary meetings of the Society are held on the first and third Friday of each month, from October to May inclusive. The society possesses a library of over 40,000 volumes, which is specially rich in the files of the publications of the learned societies of the world, and is housed in a fire-proof building erected in Independence Square on land granted to it by the State of Pennsylvania in 1785.

I. MINIS HAYS,
Secretary American Philosophical Society.

American Political Issues, 1788-1852. By this term is here meant the issues which swayed the voters in the Presidential elections, and in the congressional elections of the Presidential years. These elections were the «round-up» or register

of the accumulated drift during the four years previous, and formed one of the influences deciding the drift during the next four. They fall into five periods: 1788–1800, 1804–12, 1816–20, 1824–40, 1844–52. In the first, the Federalists are in power; the controlling issues are those of strong *v.* weak government, and of deference to the educated classes *v.* the *vox populi.* In the second, the Federalists are the opposition, fling away the excuse for their existence, and after a casual sectional revival are extinguished. In the third, there are no issues and no party, properly speaking; the candidate is accepted by inertia from the old line of leaders, and the administration is able to grant the chief wishes of both the old sections. In the fourth, the former Federalist elements recombine under new names, with the basis of a strong spending and nationalizing government, replacing the dead issue of a strong executive one. In the fifth, the slavery question is the central issue.

1788.— The division over candidates has usually and naturally coincided with the division over policies; but in the first election, of 1788, it was not so. There was but one possible candidate, Washington; he represented all parties. He had seen the Revolution nearly aborted first, and the Confederation nearly wrecked afterward, by the weakness of the central government; this confirmed his natural bias as a "nationalizing" Federalist, anxious above all things for a government which could keep order, pay its debts, and secure respect from other nations. On the other hand, as a Southern farmer, he commanded the confidence of that section, which distrusted the Northern commercial interests; and as Washington, he was the idol of the masses everywhere. Furthermore, the very basis of the election had cut the ground from under the chief opposition party. The overshadowing issue, almost the only one, of the Confederation,— which had no president nor regular elections, but only scattering "by-elections" of congressmen,— was whether it should be replaced by a stronger government; the adoption of the Constitution had settled that, and the Anti-Federalists were shut down to voting for the personnel to administer a system they disliked and dreaded. Besides this, all their ablest sympathizers were Federalists for the time being, not from love of a strong government but experience of too weak a one; so that "Federalist" for election purposes meant not so much a party as almost every one in the country of capacity, experience, or business or intellectual standing.

1792.— Again Washington was the unanimous candidate. The same men substantially were sent to Congress; indeed, there were few Anti-Federalists to send who would not discredit and weaken the cause. But the Anti-Federalist voters had the less hesitation, because their natural leaders had now begun to split away and lay the foundations of the Democratic-Republican party. Jefferson was the first to take a stand against the Federalist policy, in the matter of the Bank; shortly reinforced by Madison and Edward Randolph.

1796.— Washington, who could have held the office for life, refused it further. There was now a contest over policies represented by candidates identified with them, and each representing a section as well: John Adams stood for the Northern commercial States, with most to lose from conflicting local impositions on commerce, or foreign depredations and restrictions which a weak government could not repel; Jefferson, the lifelong champion of the extreme democratic principle,— the least government, the cheapest, and the most unshowy, possible,— stood for the mass of farmers, largely in the South and West, who simply wished to be let alone and have no taxes, and thought commerce of no benefit or concern to them. The latter also formed a part of the rapidly growing mass who resented the Federalist claim that political office needed any superior ability or training, and were eager to pass it around in rotation. Quite as strong as either was the sympathy of the masses for the French Revolution, which the Federalists detested. The latter won, but only by grace of two Southern electors and in reality by a single vote; they lost save for these the entire South beyond Maryland, and all but one electoral vote of Pennsylvania as well. In a word, the party had represented a temporary national necessity which was ceasing to be imperative, and a minority business interest; and as the former vanished, it was shrinking to the basis of the latter.

1800.— For the personal feuds which rent the Federalists in twain, see ADAMS, JOHN, and HAMILTON, ALEXANDER; but the influence of these in defeating the party is always overrated. If Hamilton had loved Adams like a brother, and all Adams' cabinet had been loyal and united, the general result of the election would not have been different; unless we are to suppose that New York Federalists voted for Jefferson because their chiefs hated each other, or that the party's recent policy had gained it votes since 1796, which is notoriously the reverse of truth. It had not only angered the Democrats, but displeased many of its own moderates, by the Alien Law for deporting all foreigners politically disagreeable to it, and the Sedition Law to shut the mouths of its opponents (see ALIEN AND SEDITION LAWS); the Hamilton wing had tried to force through a war with France to strengthen its domestic policy; the growing popular sentiment now was to make the United States a political island, severed from all relations with the rest of the world which would cause us difficulties. The election was decided for Jefferson by the reversal of New York's 12 electoral votes: local feuds had something to do with it, Burr's political "bossship" much; but beyond all, the growth of the country was away from Federalism, and at best the party had not one electoral vote to lose without being displaced.

1804.— Had the relations of the parties remained the same as in 1800, there is still no reason to think there would have been any return to a Federalist administration. From 1789 to 1797 their programme had been not merely the best, but the only one as a whole possessing either utility, dignity, or even safety; yet the disintegrating forces were so strong, and the squalor of the Confederation so thoroughly forgotten, that the party barely escaped expulsion in the very prime of its usefulness. Even in the next four years, its errors were trivial compared with its services, especially in creating the navy; yet it was beaten — not very heavily, but with incidents proving that its lost sections would

not come back to it. But so far from the issues remaining the same, the Federalist representatives, with that egregious blindness to the sources of popular strength which is never seen except in "practical politicians," committed the amazing folly of attempting to tie their opponents' hands by borrowing all their discarded doctrines. The Democrats in power had at once become converts to a strong government and a liberal construction of the Constitution; the Federalists, instead of outdoing them and claiming support as the originators of the policy, adopted the strict-construction theories and the decentralizing policy of their opponents. The Democrats having appropriated the Federalists' strength, the latter revenged themselves by appropriating their enemies' weakness. This was especially glaring in the case of the Louisiana Purchase, an extreme Federalist measure, and by far the greatest title of Jefferson to the name of statesman: it is quite incredible that the Federalists should have opposed this, even as partisans, or as possessing the rudiments of political common-sense. Their astute policy received its fitting reward: in 1800 Jefferson had won by 73 to 65; in 1804 he received 162 to 14.

1808.— The Democrats, having had full power to put in force their cherished theories of insularity and independence of international ties, at once proceeded to make a *reductio ad absurdum* of them, and hang them like a sack of stones about their own necks. Jefferson was placed between the upper millstone of the English right of search and impressment, ending in the bloody outrage of the Leopard on the Chesapeake (q.v.), and the nether of his own resolve not to fight, the disbelief of all parties alike in our ability to fight a naval war with England, and the determination of the North, which possessed most of the fighting resources, not to use them against England. He solved the problem by the Embargo (q.v.), which saved the need of fighting by sacrificing the commerce he did not value, and the prosperity of a section he was quite resigned to see unprosperous. The moribund Federalist party gained a galvanic life from this, which for the time looked like a real one: in 1804 it had carried only Connecticut and Delaware and part of Maryland; in 1803 it carried all New England but Vermont (the one State which had no commerce to lose), three votes from North Carolina and Delaware, and the two Marylanders as before,— 47 in all.

1812.— The same causes which had operated during the previous four years had continued with ever growing efficacy during this four. The feeling against England among the Democrats, the feeling among the Federalists that England was fighting the world's battle against Napoleon and must not be crippled, ever grew in intensity; the misery and hate in New England with its hamstrung commerce kept pace with either; a generation of youths was growing up who never saw the Revolution,— the War of 1812 was officially determined by four Southerners between 26 and 29; and the conquest of Canada, instead of a naval war where it was universally believed our entire fleet would be at once seized and impressed into the British navy, had struck the war party as a happy resource. The political campaign of 1812 was made on the issue of war or a repeal of the non-intercourse act. Madison was given a second term on the express condition of his approving the war; he detested it as strongly as Jefferson, but as the majority had its teeth set, felt that he might as well head it as any one else. He secured it by 189 to 89; the Federalists by a fusion had carried, besides their old States, New York and New Jersey, and more of Maryland. A new era seemed coming for the Federalists; but it was an illusion. They had no party principles, and not even a party candidate except a borrowed one (George Clinton); and their entire basis of life now was on an issue by its nature temporary.

1816–20.— The close of the War of 1812 extinguished the old issues. The mostly inglorious land war had been forgotten in the blaze of New Orleans; we had proved that our navy not only could fight the queen of the world on equal terms, but would never again be wantonly defied; the people were full of satisfaction at coming out so well, and of anger at the Federalists, whose chief section had carried opposition to the point of discussing secession. Federalism was in many minds tainted with treason. Furthermore, the New England capital driven out of commerce by the embargo and the war had begun to re-embark in manufacturing, wished for a protective tariff, and could only have it from the governing element, which was hopelessly Democratic. Rhode Island, the first to establish mills, was the first of the southern tier to break away from its old allegiance. Massachusetts, Connecticut, and Delaware, by small majorities, clung to the ancient faith; but in 1816 the Democrats carried 16 States with 183 votes, including the rest of New England. The government had bid for these votes by a United States Bank and a light protective tariff; and in 1820, the "Era of Good Feeling," or rather of "No Issues," Monroe was elected unanimously save for the vote of one elector, disgusted with the business "rings" growing up around the administration.

1824.— The administration still further carried out Federalist ideas by a great system of internal improvements, and by strengthening the tariff. In a word, while nominally Democratic-Republican, its policy had become so Federalized as to have a stronger hold on its new allies than on its old constituents, and the issue in 1824 was whether that policy should be sustained or reversed. John Quincy Adams and Henry Clay represented the former, in different sections; Andrew Jackson the reaction to old-fashioned Democracy, with strict construction, economy, and no intermeddling with business development; William H. Crawford the regular Democratic "machine," with no ulterior purpose but office. Thus divided, no candidate had a majority. Jackson had the most; Adams was elected by the House of Representatives, still so far dominated by educated politics as to consider Jackson an ignorant and pestilent demagogue; he made Clay — who had the lowest vote of the four, but was the Southern leader most in accord with his policy, and the most of a statesman — secretary of state. This "Coalition" (q.v., No. 2) was denounced by the enraged Jacksonites as a corrupt bargain, and the House election as defeating the people's will; but there is no reason for assuming, as is currently done, that the anger gained Jackson any electoral votes.

1828.— The Democratic reaction had gained strength, and the Jackson enthusiasm swept all the factions into his fold, by virtue of the State

conventions which had now assumed the office of nominating. On that side the issue was much more Jackson than any definite party programme; but Jackson as representing the hatred of the masses, especially the Southern and Western masses, for the "money power," for all activities of government beyond keeping itself alive, for tariffs and government subventions, and for all claim of superiority in the educated class, and all political initiative except by spontaneous popular movements. In short, Jackson was the agent of a democratic revolution, which supported him with a swarm of new men, and approved his policy of turning out the trained officials neck and heels. Adams held his vote well: the stock reasons for his defeat — his ungraciousness, his refusal to employ patronage, his revival of charges against the New England Federalists — are absurd in face of the fact that he had but one vote less than in 1824, and of Jackson's enormous plurality. No candidate representing trained statesmanship, culture, and a liberal government policy, could have won this election.

1832.— The Democratic tide swept on overwhelmingly. Jackson's unprecedented use of the veto power to defeat internal-improvement schemes voted for by members of his own party, only bound the majority more tightly to him; his war against South Carolina for attempted nullification cost him her votes, but brought him reinforcements from the nationalist section; his hostility to the Bank of the United States was a prominent issue in the canvass, and was that of his constituents. Nothing better proves the senselessness of accounting for great political results by personal factions or squabbles, than the fact that Adams in 1824 and 1828 had more electoral votes than all Jackson's opponents together in 1832.

1836.— The issues of this year were the carrying on of Jackson's policy, though its great objects had been accomplished,— the deposits had been placed in State "pet banks" instead of the United States Bank,— and his dictation of his own successor. To oppose this dictation, one party sprung up with the ardent Jacksonian Hugh L. White as nominee, another as a Georgia State Rights faction,— though Jackson had championed the Georgia rights in the matter at issue (see CHEROKEE CASE); Jackson's influence, however, was powerful enough to nominate Van Buren as the "regular" candidate, and he was elected by a much reduced vote from Jackson's.

1840.— Few men have had a worse legacy than Van Buren received in the Presidency; and few have made a better use of it. Almost his entire term was occupied by the panic of 1837 and the three years of hard times which succeeded it; caused entirely by Jackson's "monkeying" with the currency of which he knew nothing. The State banks which replaced the United States Bank as depositaries, and were used as Democratic political machinery, instead of managing the funds with discretion as the old bank had done, issued masses of notes till a tremendous inflation of the currency had created a vast land speculation; then he suddenly withdrew recognition of the paper currency and brought the whole structure down with a crash. Van Buren was a politician, but he was a sound statesman and financier and an honorable public man: he would have no more meddling by the government with the banking business for which it was unfit, even to extricate his own administration from a scrape; and after three years' struggle he established the Sub-Treasury system, to the lasting benefit of the country. But with the customary popular perspicacity, he was made the scapegoat for calamities which he had not caused and whose renewal he had prevented. Furthermore, the Whigs outbid the Democrats in avowed submission to the "popular mandate," their candidate Harrison promising to disuse the veto; they outdid them in the "popular hero" line by turning a useful but not very brilliant Indian battle into a second Marathon, or rather repeating the name without discussing the details; capped their swarms of mythical anecdotes of Jackson's homespun habits and unpretentious heroism by an equal number about Harrison, models of his hypothetical "log cabin" and bibulous reproduction of his "hard cider" days; they made bargains and absorbed both the Southern free-lance opposition parties: and by all this and their campaign of "noise, numbers, and nonsense," carried all but three old States and four small new ones, 234 to 60 — a majority which suggests that possibly the noise and nonsense were not needed nor efficacious, and a quieter campaign of sensible argument might equally have won, with a real leader like Clay and no ruinous bargains.

1844.— Harrison had barely survived his inauguration; and the usual policy of "placating" the strongest part of the opposition by giving them the Vice-Presidency (Tyler) had produced its usual and deserved fruit of turning the administration over for the whole four years to the Nullification party, except so far as the Whigs tied its hands. This under Clay's leadership they did, consolidating the party by steady war on Tyler, and heartening themselves at last to do what they had not before and did but once again — put forth a platform. It was a very compact and well-expressed one, excellent from the Whig or present Republican standpoint; but it was displaced as an issue by far more exigent and pungent practical ones. The tariff of 1842, which was almost weeded of protectionist features by the joint efforts of Tyler and the Democrats, was made one of the arguments; but the decisive one was Texas. For years the great object of the Calhoun wing of the Democrats had been to annex Texas; partly to increase slave territory and balance Northern growth, partly with the immediate aim of disrupting the Whig party by forcing it to take a position which would drive away either the Northern or the Southern wing. Tyler, deprived of Whig support, again drew near to the Calhoun party to which he had formerly belonged; in 1844 Calhoun was made secretary of state; and with this administration backing, the Calhoun party obtained control of the Democratic national convention, committed it to Texas annexation, and gave the nomination to the Southerner Polk instead of the Northerner Van Buren. Clay was asked to declare himself on this point; he wrote an evasive letter which cost him the support of the political abolitionists (see LIBERTY PARTY), who nominated a ticket of their own with disastrous results to both. The three tickets were those of Polk, Clay, and Birney; the first on the issues of protection, distribution of land sales, cutting down Presidential power, and dodging all phases of the slavery question; the

second on the "*re*-occupation of Oregon and the *re*-annexation of Texas"; the third on immediate abolition of slavery. The last-named cast only 62,300 votes; but enough of those were in New York and Michigan to turn the former's 35 and the latter's 6 electoral votes from Clay to Polk, electing the latter, bringing in Texas, and bringing on the Mexican War.

1848.— The Mexican War had been the dominant issue for a couple of years before, and the Democrats had striven to make it destructive to the Whigs by forcing them into obnoxious declarations of principle; but the latter voted supplies for it, and evaded abstract pronouncements as to its righteousness. The Wilmot Proviso (q.v.) was a heavier blow, for the Southerners looked on it as a primary touchstone of sectional loyalty, which stood above party loyalty. The one salvation was a popular moderate candidate who could be accepted by the voters to whom the Democrats were simply impossible; and such a one was found in Gen. Zachary Taylor. A Louisiana slaveholder, no Southerner could suppose he would sign a bill endangering his own property; known to dislike the veto, he could be trusted by the North to obey the verdict of Congress if it passed the Proviso; a popular hero, he commanded the great unreflecting brute vote which supposes military and civil functions somehow related. He was elected by reason of a split in the New York Democracy, the country being about evenly divided; that he was elected at all, however, is remarkable proof of the terror of the conservative masses at having the slavery firebrand thrown into politics. It was this vote which elected the Whigs Clay and Taylor (the former really elected so far as the Democratic competitor went), and the Democrats Pierce and Buchanan, each in the hope of suppressing the question altogether.

1852.— Taylor died in 16 months, and the Vice-President Fillmore completed the term; but all through the four years each of the two parties of unlimited slavery extension and slavery restriction was drawing its ranks together, and forming into the parties soon to contest the final mastery. In place of Whig and Democrat, it was increasingly North and South. Unfortunately, the South was willing to fight and the North as yet was not; and the so-called Compromise of 1850, like most compromises, was practically all on one side, the Northern Whigs letting the measure go by default. They did not like it, but the South insisted, and they had much more confidence in placating their own constituents for adhering to it than the South for not doing so; once passed, therefore, they proclaimed it a sacred and irrepealable decision, as being a "compromise," and the Fugitive Slave part as being a sacred obligation to uphold. As always, the "reopening of agitation" was executed by the Southern wing: before the Presidential nominations were made, they had determined to force the Whigs to an absolute declaration of party policy, a touchstone of legitimate membership. First at the Whig caucus of 20 April, then at the Baltimore national convention of 16 June, they insisted on the party recognizing the Compromise as a finality: in the platform, the last article, of great length and minuteness, made the Fugitive Slave Law, by name, a part of the organic constitution of the party. This was death, and the Southern Whigs must have so intended it. Gen. Scott, as a military hero, was made the candidate. The Southern Whigs, instead of voting for him on account of the Fugitive Slave plank, largely voted against him because the anti-slavery men in the convention, for no assignable reason, had voted for him, and he was said to be partial to Seward; the Northern Whigs largely voted against the platform: and the Whigs carried only four States, Massachusetts, Vermont, Kentucky, and Tennessee, and less than a third of the next Congress even nominally, a third even of that being Southerners who soon became Democrats. The Whig party was no more: "died of an attempt to swallow the Fugitive Slave Law" was the epitaph proposed for it.

FORREST MORGAN.
Connecticut Historical Society.

American Political Issues, 1856-1900. My review will begin with the year 1856 — the year in which I cast my first vote, also one in which James Buchanan was chosen President. But it must be premised that each election does not represent a debate; not infrequently it is merely a stage in a debate. It was so in 1856; it has been so several times since. Indeed, since 1840 — the famous "Log Cabin and Hard Cider" campaign of "Coon-Skin Caps," and "Tippecanoe and Tyler too," probably the most humorous, not to say grotesque, episode in our whole national history, that in which the plane of discussion reached its lowest recorded level — since 1840 there have been only six real debates, the average period of a debate being therefore 10 years. These debates were (1) that over slavery, from 1844 to 1864; (2) that over reconstruction, from 1868 to 1872; (3) legal tenders, or "fiat money," and resumption of specie payments were the issues in 1876 and 1880; (4) the issue of 1888 and 1892 was over protection and free trade; (5) the debate over bimetallism and the demonetization of silver occurred in 1896; and, finally (6), imperialism, as it is called, came to the front in 1900. Since 1856, therefore, the field of discussion has been wide and diversified, presenting several issues of great moment. Of necessity also the debates have assumed many and diverse aspects, ethnical, ethnological, legal, military, economical, financial, historical. The last is that which interests us.

Slavery Issue.— The first of the debates I have enumerated, that involving the slavery issue, is now far removed. We can pass on it historically; for the young man who threw his maiden vote in 1860, when it came to its close, is now nearing his grand climacteric. Of all the debates in our national history that was the longest, the most elevated, the most momentous, and the best sustained. It looms up in memory; it projects itself from history. As a whole, it was immensely creditable to the people, the community at large, for whose instruction it was conducted. It has left a literature of its own — economical, legal, moral, political, imaginative. So far as the historical aspect of that great debate is concerned, two things are to be specially noted. In the first place the moral and economical aspects predominated; and, in the second place, what may be called the historical element as an influencing factor was then in its infancy. The slavery debate was so long and intense that all the forces then existing were drawn into it. The pulpit, for instance, participated

actively. The physiologist was much concerned over ethnological problems, trying to decide whether the African was a human being or an animal; and, if the former, was he of the family of Cain. Thus all contributed to the discussion; and yet I am unable to point out any distinctly historical contribution of a high order; though on both sides the issue was discussed historically with intelligence and research. Especially was this the case in the arguments made before the courts and in the Scriptural dissertations; while on the political side the speeches of Seward and Sumner, of Jefferson Davis and A. H. Stevens, leave little to be desired. The climax was perhaps reached in the memorable joint debate between Lincoln and Douglas, of which it is not too much to say the country was the auditory.

Beginning in its closing stage, in December 1853, when the measure repealing the Missouri Compromise of 1820 was introduced into the Senate of the United States, and closing in December 1860, with the passage of its ordinance of secession by South Carolina, this debate was continuous for seven years, covering two Presidential elections, those of 1856 and 1860. Of the great slavery debate it may then in fine be said that, while the study of history and the lessons to be deduced from history contributed not much to it, it made history, and on history has left a permanent mark. Of the canvass of 1864, from our point of view little need be said. There was in it no great field for the historical investigator, the issue then presented to the people being of a character altogether exceptional. The result depended less on argument than on the outcome of operations in the field. Nor was it greatly otherwise in the canvass of 1868. The country was then stirred to its very depths over the questions growing out of the war. The shattered Union was to be reconstructed; the slave system was to be eradicated. These were great political problems; problems as pressing as they were momentous. For their proper solution it was above all else necessary that they should be approached in a calm scholarly spirit, observant of the teachings of history. Never was there a greater occasion; rarely has one been so completely lost. The assassination of Lincoln silenced reason; and to reason and to reason only does history make its appeal. The unfortunate personality of Andrew Johnson now intruded itself; and, almost at once, what should have been a calm debate degenerated into a furious wrangle. Looking back over the canvass of 1868, and excepting General Grant's singularly felicitous closing of his brief letter of acceptance —"Let us have peace"— I think it would be difficult for anyone to recall a single utterance which produced any lasting impression.

Reconstruction.— The debate over reconstruction, begun in 1865, did not wear itself out till 1876. In no respect will it bear comparison with the debate over slavery which preceded it. Sufficiently momentous, it was less sustained, less thorough, far less judicial. Toward its close, moreover, as the country wearied, it was gravely complicated by a new issue; for, in 1867, began that currency discussion destined to last in its various phases through the lifetime of a generation. It thereafter entered in greater or less degree into no less than nine consecutive Presidential elections, two of which, those of 1876 and 1896, actually turned on it.

Currency Issue.— The currency debate presented three distinct phases: First, the proposition, broached in 1867, known as the greenback theory, under which the interest-bearing bonds of the United States, issued during the Civil War, were to be paid at maturity in United States legal tender notes, bearing no interest at all. This somewhat amazing proposition was speedily disposed of; for early in 1869 an act was passed declaring the bonds payable "in coin." But, as was sure to be the case, the so-called "fiat money" delusion had obtained a firm lodgment in the minds of a large part of the community, and to drive it out was the work of time. It assumed too, all sorts of aspects. Dispelled in one form, it appeared in another.

It is difficult to say what the dividing issue of 1876 really was. The country was then slowly recovering from the business prostration which followed the collapse of 1873. The living debate was over material questions, the cause of the prolonged business depression and the remedy for it. The favorite specific was at first a recourse to paper money. The government printing-press was to be set in motion in place of the mint; and even hard-money Democrats of the Jacksonian school united with radical Republicans of the reconstruction period in guaranteeing a resultant prosperity. Again the teachings of history were ignored. What, it was contemptuously exclaimed in the Senate, do we care for "abroad!" From this calamity the country had been saved by the veto of President Grant in 1874; and the following year an act was passed looking to the resumption of specie payments on 1 Jan. 1879. Seventeen years of suspension were then to close. Over this measure the parties nominally joined issue in 1876. The Republicans, nominating Governor Hayes of Ohio, demanded the fulfilment of the promise; the Democrats, nominating Governor Tilden of New York, insisted on the repeal of the law. Yet it was well understood that the candidate of the Democracy favored the policy of which the law in debate was the concrete expression. The contest was thus in reality one between the "ins" and the "outs."

But not the less for that, in the canvass of 1876 a field of great political usefulness was opened up to the historical investigator; a field which, I submit, he failed adequately to develop. A public duty was left unperformed. From time immemorial to tamper with the established measures of value has been the constant practice of men of restless and unstable mind, honest or dishonest, whether rulers or aspirants to rule.

The Tariff Issue.— The administration of President Hayes was curiously epochal. During it the so-called "carpet-bag governments" disappeared from the Southern States; the country resumed payments in specie; and on 28 Feb. 1878, Congress passed over the veto of the President an act renewing the coinage of silver dollars, the stoppage of which, five years before, constituted what was destined thereafter to be referred to as "the crime of 1873." This issue, however, matured slowly. Public men, having recourse to palliatives, temporized with it; and through four Presidential elections it lay dormant, except in so far as parties pledged themselves to action calculated, in the well-nigh

idotic formula of politicians, to "do something for silver." The canvasses of 1880 and 1884 are therefore devoid of historical interest. The first turned largely on the tariff; and yet, curiously enough, the single utterance in that debate which has left a mark on the public memory was the wonderful dictum of Gen. Hancock, the candidate of the defeated opposition, that the tariff was a local issue, which a number of years before had excited a good deal of interest in his native State of Pennsylvania. Nor is the recollection of the debate of 1884 much more inspiring. It was a lively contest enough, under Grover Cleveland and James G. Blaine as opposing candidates, a struggle between the "outs" to get in and the "ins" not to go out. But a single formula connected with it comes echoing down the corridors of time, the alliterative "Rum, Romanism, and Rebellion" of the unfortunate Burchard.

That of 1888, presenting at last an issue, rose to the dignity of debate. In his annual message of the previous December the President, in disregard of all precedent, had confined his attention not only to the tariff, but to a single feature in the tariff, the duty on wool. In so doing he had, as the well understood candidate of his party for re-election, flung down the gauntlet, for only three years before the Republicans, in the Presidential platform, had laid particular emphasis on "the importance of sheep industry" and "the danger threatening its future prosperity." They had thus pledged themselves to "do something" for wool, as well as for silver, and the President now struck at wool as "the tariff-arch keystone." But, while in this debate the economist came to the front, there was no pronounced call, and, indeed, small opportunity for the historian.

Three Great Issues.— Returning to the review of our national debates, we find that in 1892 the shadow of coming events was plainly perceptible. The tariff issue had now lost its old significance; for the infant industries had developed into trade- and legislation-compelling trusts. These were suggestive of new and, as yet, inchoate problems; but to them the constituency was not prepared intelligently to address itself. Populism was rife, with its crude and restless theories; a crisis in the history of the precious metals was clearly impending with the outcome in doubt; indiscriminate and unprecedented pension-giving had reduced an overflowing exchequer to the verge of bankruptcy. The debate of 1892 accordingly dropped back to the politician's level, that of 1876, 1880, and 1884.

Of quite another character were the two canvasses of 1896 and 1900. Still fresh in memory, the echoes of these have indeed not yet ceased to reverberate; and I assert without hesitation that not since 1856 and 1860 has this people passed through two such wholesome and educational experiences. In 1896 and in 1900, as in the debates of 40 years previous, there was a place, and a larger place, for the student, whether investigator or philosopher. Great problems, problems of law, of economics and ethics, problems involving peace and war, and the course of development in the oldest as in the newest civilizations, had to be discussed on the way to a solution. That the prolonged debate running through those eight years was at all equal to the occasion I do not think can be claimed. Even his most ardent admirers will hardly suggest that Mr. Bryan in 1896 and 1900 rose to the level reached by Lincoln 40 years before, nor do the utterances of Mr. Roosevelt, Mr. Depew, or Mr. Hanna bear well a comparison with those of Seward, Trumbull, and Sumner. Indeed, in the whole wordy canvass of 1896 I now recall but two instances of the professor or philosopher distinctly taking the floor; but both of those were memorable. They imparted an elevation of tone to discussion, immediately and distinctly perceptible, in the press and on the platform. I refer to the single utterance of Carl Schurz before a small audience at Chicago on 5 Sept. 1896 and to the subsequent publications of President Andrew D. White, in which, from his library at Ithaca, he drew freely on the stores of historical experience in crushing refutation of demagogical campaign sophistry.

What were the issues of the last Presidential canvass? On what questions did its debate turn? Three in number, they were, I think, singularly inviting to those historically minded. To the reflecting man the matter first in importance was what is known as "imperialism," the problem forced on our consideration by the outcome of the war with Spain. Next I should place the questions of public policy involved in the rapid agglomerations of capital, popularly denominated trusts. Finally, the silver issue still lingered at the front, a legacy from the canvass of four years previous. The debate of 1900 is a thing of the past. Each of those issues can now be discussed, as it might well then have been discussed, in the pure historical spirit. Let us take them up in their inverse order.

Silver and Trusts.— Shortly after 1870 the policy of demonetizing silver was entered on; and in 1873 the United States gave its adhesion to that policy. Thereafter, in the great system of international exchanges, silver ceased to be counted a part of that specie reserve on which drafts were made. Thenceforth the drain, as among the financial centres, was to be on gold alone. In the whole history of man no precedent for such a step was to be found. So far as the United States was concerned the basis on which its complex and delicate financial fabric rested was weakened by one-half; and the cheaper and more accessible metal, that to which the debtor would naturally have recourse in discharge of his obligations, was made unavailable. It could further be demonstrated that without a complete readjustment of our currencies and values the world's accumulated stock and annual production of gold, could not, as a monetary basis, be made to suffice for its needs. A continually recurring contest for gold among the greatest financial centres was inevitable. "A change which," in the language of Lecky, "beyond all others affects most deeply and universally the material well-being of man had been unwittingly challenged." The only question was, Would the unexpected occur? Then, if it did occur, what might be anticipated? Such was the silver issue, as it presented itself in 1896. On the facts, the weight of argument was clearly with the advocates of silver.

Four years later, in 1900, the unexpected had occurred. As then resumed, the debate was replete with interest. The lessons of 1892 and 1896 had a direct bearing on the present, and in the light shed by them the outcome could be

forecast almost with certainty; but it was a world question. Japan, China, Hindustan, entered into the problem, in which also both Americas were factors. It was a theme to inspire Burke, stretching back, as it did, to the Middle Ages, and involving the whole circling globe. Rarely has any subject called for more intelligent and comprehensive investigation; rarely has one been more confused and befogged by a denser misinformation. The discoverer and scientist, moving hand in hand, had during the remission of the debate, been getting in their work, and under the touch of their silent influence the world's gold production rose by leaps and bounds. Less than 10,000,000 ounces in 1896, in 1899 it had nearly touched 15,000,000; and in money value it alone then exceeded the combined value of the gold and silver production of the period.

So much for the silver question and its possible treatment. In the discussion of 1900 the last word in the debate of 1896 remained to be uttered. A page in history, both memorable and instructive, was to be turned. Next, trusts — those vast aggregations of capital in the hands of private combinations, constituting practical monopolies of whole branches of industry, and of commodities necessary to man. Was the world to be subject to taxation at the will of a moneyed syndicate? The debate over this issue, if debate it may be called, is still very recent. In it the lessons of history were effectually ignored; and yet, if applied, they would have been sufficiently suggestive. The historian was as conspicuous for his absence as the demagogue was in evidence.

The curious feature in the present discussion, that which in the mind of the student of things as opposed to words imparts a special interest to it, is that, while the trust of vast aggregation of capital and machinery of production in the hands of individuals intended to control competition is in fact the modern form of monopoly, is is in its methods and results the direct opposite of the old time monopoly; for, whereas the purpose and practice of that was to extort from all purchasers an artificial price for an inferior article through the suppression of competitors, the first law of its existence for the modern trust is, through economies and magnitude of production, to supply to all buyers a better article at a price so low that other producers are driven from the market. The ground of popular complaint against them is not that they exact an inordinate profit on what they sell, but that they sell so low that the small manufacturer or merchant is deprived of his trade. This distinction with a difference explains at once the wholly futile character of the politician's outcry against trusts. It is easy, for instance, to denounce from the platform the magnates of the sugar trust to a sympathizing audience; and yet not one human being in that audience, his sympathies to the contrary notwithstanding, will the next morning pay a fraction of a cent more per pound for his sugar, that by so doing he may help to keep alive some struggling manufacturer who advertises that his product does not bear the trust stamp.

As to the outcome of conflicts of this character history tells but one story. They can have but one result, a readjustment of industries. A single familiar illustration will suffice. Any one who chooses to turn back to it can read the story of the long conflict between the loom and the spindle. Formerly, and not so very far back, the distaff and spinning-wheel were to be seen in every house; homespun was the common wear. To-day the average man or woman has never seen a distaff, or heard the hum of a spinning-wheel. Ceasing long since to be a commodity, homespun would be sought for in vain. Yet the struggle between the loom of the manufacturing trust and the old dame's spinning-wheel was, literally, for the latter a fight to the death. The operator's time was worth absolutely nothing except at the wheel; she must needs work for any wage; on it depended her bread. A vast domestic, industrial readjustment was involved; one implying untold human suffering. The result was, however, never for an instant in doubt. The trust of that day was left in undisputed control of the field; and it always must, and always will be, just so long as it supplies purchasers with a better article at a lower price than they had to pay before. The process does not vary; the only difference is that each succeeding readjustment is on a larger scale and more far-reaching in its effects.

Such, stripped of its verbiage and appeals to sympathy, is the trust proposition. But the popular apprehension always has been, as it now is, that this supply of the better article at a lower price will continue only till the producer, the monopolist, has secured a complete mastery of the situation. Capital, it is argued, is selfish and greedy, corporations are proverbially soulless and insatiable; and, as soon as competition is eliminated, nature will assert itself. Prices will then be raised so as to assure inordinate gains; and when, in consequence of such profits, fresh competitors enter the field, they will either be crushed out of existence by a temporary reduction in price, or absorbed in the trust. All this has a plausible sound; and of it as a theory of practical outcome the politician can be relied on to make the most. But on this head what has the historical investigator to say? His will be the last word in that debate also; his verdict will be final. The lessons bearing on this contention to be drawn from the record cover a wide field of both time and space; they also silence discussion. They tend indisputably to show that the dangers depicted are imaginary. The subject must, of course, be approached in an unprejudiced spirit and studied in a large, comprehensive way. Permanent tendencies are to be dealt with; and exceptional cases must be instanced, classified, and allowed for. Attempts, more or less successful, at extortion in a confidence of mastery, can unquestionably be pointed out; but in the history of economical development it is no less unquestionable that, on the large scale and in the long run, every new concentration has been followed by a permanent reduction of price in the commodity affected thereby. The world's needs are continually supplied at a lower cost to the world. Again, the larger the concentration the cheaper the product; till now a new truth of the market place has become established and obtained general acceptance, a truth of the most far-reaching consequence, the truth that the largest returns are found in quick sales at small profits.

Does history furnish any instance of a financial, an industrial, or a commercial enterprise — a bank, a factory, or an importing company — ever having been powerful enough long to regu-

late the price of any commodity regardless of competition except when acting in harmony with and supported by governmental power? Is not the monopolist practically impotent unless he has the constable at his call? To answer this question absolutely would be to deduce a law of the first importance from the general experience of mankind. So doing would call for a far more careful examination than is now in my power to make, were it even within the scope of my ability; but if my supposition prove correct the corollary to be drawn therefrom is to us as a body politic and at just this juncture one of the first and most far-reaching import. In such case the modern American trust, also, so far as it enjoys any power as a monopoly, or admits of abuse as such, must depend for that power and the opportunity of abuse solely on governmental support and cooperation. Its citadel is then the custom-house. The moment the United States revenue officer withdrew his support the American monopolist would cease to monopolize, except in so far as he could defy competition by always supplying a better article at a price lower than any other producer in the whole world.

The Issue of Imperialism.— It remains to pass on to the third and last of the matters in debate during 1900, that known as imperialism. This was the really great issue before the American people then; and it is the really great issue before them now. That issue, moreover, I with confidence submit, can be intelligently considered only from the historical standpoint. Indeed, unless approached through the avenues of human experience, it is not even at once apparent how the question, as it now confronts us, arose and injected itself into our political action; and accordingly, it is in some quarters even currently assumed that it is there only fortuitously, a feature in the great chapter of accidents, a passing incident, which may well disappear as mysteriously and as suddenly as it came. Studied historically, I do not think this view of the situation will bear examination. On the contrary, I fancy even the most superficial investigator, if actuated in his inquiry by the true historical spirit, would soon reach the conclusion that the issue so recently forced on us had been long in preparation, was logical and inevitable, and for our good or our evil must be decided, rightly or wrongly, on a large view of great and complex conditions.

Leslie Stephen, in one of his essays, truly enough says: "The Catholic and the Protestant, the Conservative and the Radical, the Individualist and the Socialist, have equal facility in proving their own doctrines with arguments which habitually begin, 'All history shows.' Printers should be instructed always to strike out that phrase as an erratum, and to substitute 'I choose to take for granted.'" And elsewhere the same writer lays it down as a general proposition that: "Arguments beginning 'All history shows' are always sophistical." What is by some known as the doctrine of manifest destiny is, I take it, identical with what others, more piously minded, refer to as the will, or call, of God. The Mohammedans say: "God clearly calls us" to this or that work; and with a conscience perfectly clear proceed to rob, slay, and oppress. In like manner the political buccaneer and land pirate proclaims that the possession of his neighbor's territory is rightfully his by manifest destiny. The philosophical politician next drugs the conscience of his fellowmen by declaring solemnly that "all history shows" that might is right; and with time, the court of last appeal, it must be admitted possession is 9 points in the law's 10. It cannot be denied, also, that quite as many crimes have been perpetrated in the name of God and of manifest destiny as in that of liberty. That, at least, "all history shows." But, all the same, just as liberty is notwithstanding a good and desirable thing, so God does live and will, and there is something in manifest destiny. As applied to the development of the races inhabiting the earth it is, I take it, merely an unscientific form of speech; the word now in vogue is evolution, the phrase "survival of the fittest." When all is said and done that unreasoning instinct of a people which carries it forward, in spite of and over theories to its manifest destiny, amid the despairing outcries and long-drawn protestations of theorists and ethical philosophers, is a very considerable factor in making history; and consequently one to be reckoned with.

In plain words, then, and Mr. Stephen to the contrary notwithstanding, "all history shows" that every great, aggressive, and masterful race tends at times irresistibly toward the practical assertion of its supremacy, usually at the cost of those not so well adapted to existing conditions. In his great work Mommsen formulates the law with a brutal directness distinctly Germanic: "By virtue of the law that a people which has grown into a state absorbs its neighbors who are in political nonage, and a civilized people absorbs its neighbors who are in intellectual nonage — by virtue of this law, which is as universally valid and as much a law of nature as the law of gravity — the Italian nation (the only one in antiquity which was able to combine a superior political development and a superior civilization, though it presented the latter only in an imperfect and external manner) was entitled to reduce to subjection the Greek States of the East which were ripe for destruction, and to dispossess the peoples of lower grades of culture in the West — Libyans, Iberians, Celts, Germans — by means of its settlers; just as England with equal right has in Asia reduced to subjection a civilization of rival standing, but politically impotent, and in America and Australia has marked and ennobled and still continues to mark and ennoble extensive barbarian countries with the impress of its nationality."

The following quotation I must commend to the thoughtful consideration of those classified in the political nomenclature of the day as Anti-Imperialists. A most conscientious and high-minded class, possessed with the full courage of their convictions, the efforts of the Anti-Imperialists will not fail, we and they may rest assured, to make themselves felt. They enter into the grand result. Nevertheless, for them there is food for thought, perhaps for consolation, in this other general law, laid down in 1862 by Richard Cobden:

"From the moment the first shot is fired, or the first blow is struck, in a dispute, then farewell to all reason and argument; you might as well attempt to reason with mad dogs as with men when they have begun to spill each other's blood in mortal combat. I was so convinced of the fact during the Crimean War, which, you know, I opposed, I was so convinced of the utter uselessness of raising one's voice in opposition

to war when it was once begun that I made up my mind that as long as I was in political life, should a war again break out between England and a great power, I would never open my mouth on the subject from the time the first gun was fired till the peace was made, because when a war is commenced it will only be by the exhaustion of one party that a termination will be arrived at. If you look back at our history what did eloquence in the persons of Chatham or Burke do to prevent a war with our first American colonies? What did eloquence in the persons of Fox and his friends do to prevent the French Revolution, or bring it to a close? And there was a man who at the commencement of the Crimean War opposed it in terms of eloquence, in power, and pathos, and argument equal — in terms, I believe, fit to compare with anything that fell from the lips of Chatham and Burke — I mean your distinguished townsman, my friend Mr. Bright — and what was his success? Why, they burnt him in effigy for his pains."

Turning from the authorities and the lessons by them deduced from the record called history, let us now consider the problem precipitated on the American people by the Spanish war of 1898. The first and most important lesson is one which, in theory at least, is undisputed; though to live up to it practically calls for a courage of conviction not yet in evidence. That a dependency is not merely a possession, but a trust, a trust for the future, for itself, and for humanity, is accepted by us in this debate as a postulate. Accordingly, our dependencies are in no wise to be exploited for the general benefit of the alien owner, or that of individual components of that owner, but they are to be dealt with in a large and altruistic spirit with an unselfish view to their own utmost development, materially, morally, and politically. And, through a process of negatives, "all history shows" that only when this course is hereafter wisely and consecutively pursued, should that blessed consummation ever be attained, will the dominating power itself derive the largest and truest benefit from its possessions. As yet no American of any character, much less of authority, has come forward to controvert this proposition. But, assuming the correctness of the proposition I have just formulated, a corollary follows from it. A formidable proposition, I state it without limitations, meaning to challenge contradiction, I submit that there is not an instance in all recorded history, from the earliest precedent to that now making, where a so-called inferior race or community has been elevated in its character, or made self-sustaining and self-governing, or even put on the way to that result, through a condition of dependency or tutelage. I say "inferior race"; but, I fancy, I might state the proposition even more broadly. I might without much danger assert that the condition of dependency, even for communities of the same race and blood, always exercises an emasculating and deteriorating influence. I would undertake, if called on, to show also that this rule is invariable — that from the inherent and fundamental conditions of human nature it has known and can know no exceptions. This truth, also, I would demonstrate from well-nigh innumerable examples, that of our own colonial period among the number. In our case it required a century to do away in our minds and hearts with our dependential traditions. The Civil War and not what we call the Revolution was our real war of independence. And yet in our time of dependency you will remember we were not emasculated into a resigned and even cheerful self-incapacity as the natural result of a kindly, paternal, and protective policy; but, as Burke with profound insight expressed it, with us the spirit of independence and self-support was fostered "through a wise and salutary neglect." But, for present purposes, all this is unnecessary, and could lead but to a poor display of commonplace learning. The problem to-day engaging the attention of the American people is more limited. It relates solely to what are called "inferior races"; those of the same race, or of cognate races, we as yet do not propose to hold in a condition of permanent dependency; those we absorb or assimilate. Only those of "inferior race," the less developed or decadent, do we propose to hold in subjection, dealing with them, in theory at least, as a guardian deals with a family of wards.

What History Teaches.— My proposition then broadens. If history teaches anything in this regard it is that race elevation, the capacity in a word for political self-support, cannot be imparted through tutelage. Moreover, the milder, the more paternal, kindly, and protective the guardianship, the more emasculating it will prove. A "wise and salutary neglect" is the more beneficent policy; for, with races as with individuals, a state of dependency breeds the spirit of dependency. Take Great Britain, for instance. That people, working at it now consecutively through three whole centuries, after well-nigh innumerable experiences and as many costly blunders, Great Britain has, I say, developed a genius for dealing with dependencies, for the government of "inferior races"; a genius far in advance of anything the world has seen before. Yet my contention is that, to-day, after three rounded centuries of British rule, the Hindus, the natives of India, in spite of all material, industrial and educational improvements — roads, schools, justice, and peace — were in 1900 less capable of independent and ordered self-government, than they were in the year 1600, the year when the East India Company was incorporated under a patent of Elizabeth. The native Indian dynasties, those natural to the Hindus, have disappeared; accustomed to foreign rule, the people have no rulers of their own, nor could they rule themselves. The rule of aliens has with Hindustan thus become a domestic necessity. Remove it — and the highest and most recent authorities declare it surely will some day be removed — chaos would inevitably ensue. What is true of India is true of Egypt. Schools, roads, irrigation, law and order, and protection from attack, she has them all —

> "But what avail the plow or sail,
> Or land or life, if freedom fail?"

The capacity for self-government is not acquired in that school.

But of this England itself furnishes an example in its own history, an example well-nigh forgotten. In fundamentals human nature is much the same now as 20 centuries back. During the first century of the present era the Romans, acting in obedience to the law laid down by Mommsen — the law quoted by me in full, and the law of which Thomas Carlyle is the latest and

most eloquent exponent, the law known as the Divine Right of the most Masterful — acting in obedience to that law the Romans in the year of grace 43 crossed the British channel, overthrew the Celts and Gauls gathered in defense of what they mistakenly deemed their own, and, after reducing them to subjection, permanently occupied the land. They remained there four centuries, 100 years longer than the English have been in Calcutta. During that period they introduced civilization, established Christianity, constructed roads, dwellings and fortifications. Materially, the condition of the country vastly improved. The Romans protected the inhabitants against their enemies; also against themselves. During hundreds of years they benevolently assimilated them. Doubtless on the banks of the Tiber the inhabitants of what is now England were deemed incapable of self-government. Probably they were; unquestionably they became so. When the legions were at last withdrawn, the results of a kindly paternalism, secure protection, and intelligent tutelage became apparent. The race was wholly emasculate. It cursed its independence; it deplored its lost dependency. As the English historian (Green) now records the result: "They forgot how to fight for their country when they forgot how to govern it."

Man is always in a hurry; God never! is a familiar saying. Certainly, nature works with a discouraging indifference to generations. Each passing race of reformers and regenerators does indisputably love to witness some results of its efforts; but, in the case of England, in consequence of the emasculation incident to tutelage and dependency on a powerful, a benevolent, and beneficent foreign rule, after that rule ended — as soon or late such rule must always end — throughout the lives of 18 successive generations emasculated England was overrun. At last, with some half dozen intermediate rulers, the Normans succeeded the Romans. They were conquering masters; but they domesticated themselves in the British Islands, and in time assimilated the inhabitants thereof, Saxons, Picts, and Celts, benevolently or otherwise. But, as nearly as the historian can fix it, it required 800 years of direst tribulation to educate the people of England out of that spirit of self-distrust and dependency into which they had been reduced by four centuries of paternalism, at once Roman and temporarily beneficent. Twelve centuries is certainly a discouraging term to which to look forward. But steam and electricity have since then been developed to a manifest quickening of results. Even the pace of nature was in the 19th century vastly accelerated.

Briefly stated then, the historical deduction would seem to be somewhat as follows: Where a race has in itself, whether implanted there by nature or as the result of education, the elevating instinct and energy, the capacity of mastership, a state of dependency will tend to educate that capacity out of existence; and the more beneficent, paternal, and protecting the guardian power is, the more pernicious its influence becomes. In such cases the course most beneficial in the end to the dependency, now as a century ago, would be that characterized by "a wise and salutary neglect." Where, however, a race is for any cause not possessed of the innate saving capacity, being stationary or decadent, a state of dependency while it may improve material conditions, tends yet further to deteriorate the spirit and to diminish the capacity of self-government; if severe, it brutalizes, if kindly, it enervates.

CHARLES FRANCIS ADAMS,
Historian and Diplomat.

American Printing Trade. Although the printing trade had its inception in America considerably prior to the Revolutionary War, it was not until some time after the conclusion of that struggle for liberty that it began to assume the proportions of a national industry. In the year 1775, for example, there were less than 100 printing establishments upon American soil, and these were almost exclusively confined to the coast towns. Even as late as the year 1810 there were but 35 printing shops scattered about throughout the interior of the country, while, in 1775, with the exception of the two or three offices that were located in Massachusetts and Pennsylvania, the art of printing had no inland representation. A few years later a printing establishment was opened at Lexington, Ky.; another soon followed at Pittsburg, Pa., and the third office was finally located at Cincinnati, Ohio. In almost every instance these printing offices were established for the primary object of printing newspapers, although each of them not only possessed the necessary facilities for the production of jobwork, but were also able to print and bind books on the rare occasions upon which such contracts presented themselves.

From the earliest days in the history of the printing trade in America, New York, Philadelphia, and Boston have been the three great centers of this industry. Other seaport towns had their local shops, but the bulk of their business was small. In fact, during the first 50 years in the life of the new nation it was Philadelphia that took the lead in every branch of the printing industry, and, by the beginning of the 18th century the Quaker City presses, of which there were no less than 110 constantly in operation, were producing more English publications than any city in the world, with the single exception of London. It was here that Matthew Carey, the first great American publisher, established his plant, and with all its daily and weekly newspapers, and its book-printing and binding establishments, Philadelphia was indeed the most important center of the American printing trade.

Gradually, however, as the demands for printed works increased, other cities came into line, Albany, Hartford, and Worcester being among those that developed a comparative large trade. Their chief industry was in the printing of pamphlets. The newspapers of that day contained so little matter that they were easily read, and, as they were passed from man to man, their numerical circulation was extremely small. As the result, therefore, little effort was made to enlarge them, and persons who, like the politicians, wished to reach the general public were compelled to address themselves to the people through the medium of pamphlets. So far as actual literature was concerned the country was practically devoid of authors, and the books which were printed upon American presses were almost exclusively those which had been pirated from English publishers. Later some religious and technical books appeared, but it was many years before general literature began to display any marked degree of development.

In the beginning everything that was used

in the art of printing was imported from England. The American printers had English presses. It was from England that they obtained their type. Even the better qualities of printer's ink was imported, for the ink that was produced in this country was of such an inferior grade that it could be used only in the roughest kinds of jobs. From time to time various American printers made some slight improvements upon the old presses, but no great evidence of progress was shown until the establishment of a permanent type foundry.

Although it was the latter part of the 18th century before there was any permanent establishment for the making of type in this country, several attempts had previously been made to introduce such an innovation in the printing trade. As early as 1775 Benjamin Franklin had sent the complete equipment for a type foundry from Paris, but the attempt to establish this branch of the industry was not a financial success, and it was accordingly soon discontinued. Some ten years later a Scotch firm opened a foundry in Philadelphia, but it did not thrive, and the few other scattered efforts that were made to provide American workmen with American-made type met with the same fate. In 1796, however, two Scotchmen opened a type foundry in Philadelphia under the firm name of Binny & Ronaldson, and, as the time now seemed ripe for such an establishment, they were sufficiently successful to be able to continue operations. In 1805 another foundry was opened by the firm of Wing & White, in Hartford, but they found themselves unable to compete with the Philadelphia foundry until, in 1810, the establishment was removed to New York. Two years later the firm of David & George Bruce established a stereotyping plant in New York, and, when the already established foundries refused to supply them with type for their operations, they began to cast it for themselves, and soon became one of the most successful type-making houses in America. Their success, in fact, as much as the increasing demand for type, inspired others to follow their example. In 1816 a foundry was established in Boston; in 1817 another was opened in Baltimore, and, by 1830, there were no less than twelve foundries in full operation in various parts of the country. At the present time there are about thirty of these foundries in the United States, many of which are under the control of the American Type-Founders Company.

In the early days of the printing trade in America stereotyping was, of course, unknown, and the local publishers were accordingly compelled to recompose the type for each new edition that might be required. The introduction of stereotyping by the Bruces in 1813, therefore, suggested such economy that the enterprise could scarcely have failed to meet with favor at the hands of the printers. While the plaster process, the first method of stereotyping in vogue, was invented in England by Lord Stanhope, tidings of this great discovery were soon brought to this country, and David Bruce at once set sail for the old world for the express purpose of securing the information that would enable him to make practical use of the new invention in America. Although the stories that had reached this country had pictured the new discovery as a perfected invention, Lord Stanhope's experiments had actually by no means been concluded, and, as the result, Bruce found it impossible to acquire anything more than the most superficial knowledge concerning the process. Finding that all material facts were being withheld from him, and that it would be useless to attempt to persuade Lord Stanhope to disclose his secret, Bruce returned to the United States. So far from admitting his defeat, however, he promptly went to work, and, with the little information he had obtained, he managed by his own genius and mechanical skill to make a plate that was in every respect superior to any that had as yet been cast in England. Through his own diligence he had mastered the defects which Lord Stanhope had been unable to overcome, for his plate was not only perfectly level on both sides, but it was of uniform thickness in every part. In fact, so successful was he that an Englishman named Watts, who had succeeded in learning his process, went back to Europe with his knowledge. There he found scores of master-printers who, disgusted with the English invention, were glad to be taught how the American plates were made, and it was through his efforts that both Austria and Germany acquired the art of stereotyping.

From the day on which David & George Bruce opened their foundry in New York they had all the orders that they could fill, for American publishers were quick to appreciate the economical advantage of the new invention. It was the time when the public was just beginning to demand books, and as the plaster casts were not only made without great expense but also guaranteed plates of great durability, printers were eager to stereotype all books that might by any possibility require a second edition. From this simple beginning, therefore, came the great stereotyping industry of America. By 1850, the year in which the making of plaster plates attained its greatest development, there were more than 50 firms engaged in this business in the United States, while more than 1,000 men were employed in the work. Then came the modern improvements — the electrotyping for book-work and the introduction of the papier-mache process in the making of newspapers — since which time the making of plates has become practically an art by itself.

Prior to 1805 comparatively little printer's ink was made in this country. Although printers were supposed to know how to mix the compound, the preparations that they concocted proved such a poor substitute that all the good inks were imported. In 1805, however, two firms — one in Philadelphia and the other in Cambridgeport — began the manufacture of printing ink, and, since that time, the industry has been steadily extended until there are now about 35 firms engaged in this branch of the printing trade. About 1860 the cheapness of aniline colors inspired a more general use of colored inks, but as many of these tints soon lost their brilliancy they did not become very popular until the chemists had succeeded in correcting this fault.

The period between 1810 and 1833 witnessed many great improvements in the art of printing. One of the most important innovations was the substitution of iron for wood in the making of hand presses. Although wooden presses had been used since the time of Gutenberg they had always proved a handicap to good printing.

Even the strongest wood was weak, and as the machine was liable to give way in some part at any pull, the pressmen found it impossible to obtain a good impression, even when the type surface was no larger than 12 by 20 inches. As the natural result, all hand-presses were small affairs, and as they required the services of two expert workmen to keep them going the process was as costly as it was slow. In the adoption of the iron press American printers followed the example of their English brethren. The first iron press to be made in America was completed about 1820, but, sometime previous to that date, such presses had been imported from England. Recognizing the advantage of a machine that was capable of printing a sheet three times as large as the old press and with no greater muscular effort, American printers soon demanded them, but, in spite of this demand, it was several years before the wooden presses were relegated to the junk-heap, some of them having been in use, even in New York, as late as 1850. In the beginning presses were made by Turney, Worrall, Wells, and Smith, but gradually the business began to center with Hoe in New York and Ramage & Bronstrup in Philadelphia, until, finally, nearly all the presses were manufactured by these houses.

Another invention that proved an invaluable aid to the progress of the art of printing was the making of elastic rollers for inking the type. The original method of inking was a most laborious system, the application of the ink being made with balls of pelt. Early in the 19th century, however, an English compositor discovered that a composition of glue and molasses, long used in the making of pottery, could be applied in the inking of type, and from this idea was evolved the composition roller which was so necessary to the success of the first machine presses. This roller was first employed in this country about 1826. Another invention that played an important part in the production of cheap printing was the improved method of paper manufacture which came with the introduction of Fourdrinier's machine. This, too, was introduced in America soon after 1826, and, since that time the growth of the printing industry has been a steady and rapid evolution.

Of course, the great necessity under the new conditions was more rapid printing facilities, and this demand was met by the inventors about 1829. Some 15 years prior to that time a German printer named Konig went to England to produce a cylinder machine for the use of the London *Times*. While the press that he constructed was rather successful, he returned to Germany before it was perfected, leaving the English inventors to complete the improvement of his work. This they did in many respects, but the credit for the first actual success in the making of cylinder presses is due to the American manufacturers, firms like R. Hoe & Co., who took the somewhat unsatisfactory foreign machines and brought them to a state of comparative perfection. By depending only upon good material and thorough workmanship they produced cylinders that were so much more satisfactory than the foreign goods, that, in spite of the fact that the home product is cheaper, English printers have long found it expedient either to import American printing machines, or to make their own presses from American models.

After 1833, therefore, America needed no further help from England in the development of her printing industry. With the best of paper, ink, type, and presses, all made in this country, and with plenty of money to invest in manufacturing enterprises connected with this trade, it was unnecessary for her to turn to any foreign nation for assistance, and when, in 1830, the system of cloth book-binding was introduced, all the requisites for literary progress were in her own hands.

Of course, with the development of the power press the character of the newspapers of this country also began to change. Whereas they had originally been small and dull, having but little news in them, the ability to print many copies enabled them to increase their circulation as well as their size. In 1833 the New York *Sun*, printing a sheet 11½ by 17 inches on a hand press, could not produce more than 400 copies an hour. As the demand for the paper continued to increase, however, a cylinder press, propelled by a man at a crank, was introduced in 1834, and a year later, this was supplanted by a double-cylinder operated by steam power. As other papers in other parts of the country met with similar experiences, the demand for rapid newspaper presses continued, and, by 1845, it was found that even the double-cylinder machine was too slow for the requirements of the constantly growing circulation of the great dailies. See American Newspapers.

It was to comply with this demand that R. Hoe & Co., in 1847, invented the type-revolving rotary printing press, a machine in which the type was fastened to the cylinder and successively presented to each of the impression cylinders placed around it. For more than 20 years this press was able to meet every demand of periodical publications, but, in 1869, finding that it had at last become too slow, R. Hoe & Co. perfected their web-printing machine, a press which prints continuously from stereotyped plates on a cylinder against an endless roll of paper. In spite of the almost incredible speed at which this press can be run, other inventions, which have since been perfected, now enable it, not only to print 4, 8, 12, or even more pages, but at the same time, to fold, count, and paste them; to insert sheets or add the necessary covers, or even to print illustrations in many colors. In 1854 William A. Bullock perfected the first cylinder machine that was capable of printing a newspaper from a roll on both sides at the same time, but the other improvements have been the work of R. Hoe & Co., or some of their business rivals like Cottrell, Babcock, Campbell, Potter, Huber, Miehle, Joss, and others.

Great as has been the improvement in the making of machine-presses, however, the other branches of the art of printing have succeeded in keeping pace with it. In stereotyping, for example, the invention of the papier-mache process enabled printers to make a number of impressions of the same page of type, while the demand for a convex plate was met, in 1854, when Charles Craske, of New York, succeeded in stereotyping a curved surface.

The period between 1833 and the outbreak of the Civil War also witnessed many improvements in the art of printing, the most important being the introduction of fast printing in fine book and job work. The invention of the power

press had been a blessing to the newspapers, but, for a long time, book and fine job work was still done on hand presses. It was not until 1836 that Harper & Brothers introduced a power-press, although Daniel Fanshaw of New York, the printer of the Bible Society, had 10 power printing machines in operation in his shop prior to that time. These machines were manufactured by Daniel Treadwell of Massachusetts, and, although they were both bulky and inconvenient, they were the best presses on the market until the Adams press came to take their place. During all this period, however, it was believed that cylinder machines were incapable of doing fine work, and it was not until Francis Hart, of New York, had demonstrated the fallacy of this theory that the incredulous could be persuaded to make the change which the proper development of the trade had so long demanded.

To Joseph A. Adams belongs the credit of devising the American method of making-ready woodcuts, and he it was who first demonstrated the feasibility of the new process of electrotyping by making successful electrotype plates, in 1839. It was in 1838 that the type-casting machine was invented by David Bruce, and about 1850 that the method of printing illustrations on dry paper was discovered.

The art of engraving on wood was practiced until comparatively recent times, but the introduction of the art of photo-engraving destroyed its usefulness, for, while wood engravings were extremely costly, the new process made the cheapest of illustrations possible. Lithography, or the art of printing upon stone, has been employed in the United States since 1819. It was not until 1825 that its use became commercially practicable, but, since that time, this form of printing has developed so rapidly that, in 1904, the amount of such work done was estimated to be nearly $40,000,000, a production which required the employment of more than 9,000 persons.

One of the latest, and, unquestionably, one of the greatest improvements in the art of printing was the invention of the typesetting machine, which is now in such general use in all large establishments that it may be said to have practically supplanted hand composition. It is by such inventions, however, that the printing trade has been revolutionized until it has grown from the small proportions of a business which engaged the attention of less than 500 men to a great national industry, in which the capital invested, according to the 1904 estimate, is in excess of $300,000,000, that has an annual output that is valued at more than $350,000,000, and which gives employment to not less than 175,000 persons. ALBERT BUCKLEY NICHOLS,

The Herald Company of Binghamton.

American Protective Association, or "A. P. A.," a secret order organized throughout the United States and Canada. Its chief doctrine, as announced in its declaration of principle, is that "subjection to and support of any ecclesiastical power not created and controlled by American citizens, and which claims equal, if not greater, sovereignty than the government of the United States of America, is irreconcilable with American citizenship"; and it accordingly opposes "the holding of offices in national, State, or municipal government by any subject or supporter of such ecclesiastical power." Another of its purposes is to prevent all public encouragement and support of sectarian schools. It does not constitute a separate political party, but seeks to control existing parties, and to elect friendly and defeat objectionable candidates by the concerted action of citizens affiliated with all parties, much after the style of the American or "Know-Nothing" party. The order was founded 13 March 1887, and in 1900 claimed a membership of over 2,000,000.

American Psychological Association, a society founded in 1892 for the advancement of psychology as a science. Persons are eligible to membership who are engaged in this work. Membership, 135. Office of secretary, Columbia University, New York.

American Publishing. The book trade or publishing industry in the New World had its origin in a more remote period than is generally supposed. It began within 100 years of the invention of printing, and from the date of the first American book, 1535, to the year 1799, over 7,000 different books had been published, nine tenths of them however being pamphlets. The 19th century saw almost the full development of book publishing, the establishment of colleges and schools and the founding of many libraries, creating an ever-increasing demand for the best in literature.

Early American Books.— The first book printed on the American continent is said to have been "La Escalera Spiritual de San Juan Climaco," published in Mexico in 1535. It was a translation from the Latin into Castilian. Other books were printed on the first press set up in Mexico and six or seven books are known to have been published in Peru before 1600. In the United States the earliest publication was a pamphlet called "The Freeman's Oath," printed in Boston in 1639. This was followed in the year 1640 by the "Bay Psalm Book," printed by Stephen Daye at Cambridge, Mass. After its publication in the colony it was reprinted in England, where it went through 17 editions, the last one bearing the date of 1754. It was also a highly popular work in Scotland, 22 editions having been printed there, the last dated 1759. The first original American book published in this country was Mrs. Anne Bradstreet's "Poems," and this volume, issued in Cambridge, Mass., in 1640, was republished in London in 1650. Cambridge remained the only publishing town for a long time, and for 21 consecutive years issued about one volume a year. In 1653 Samuel Green published John Eliot's famous "Catechism" in the Indian language, followed in 1659 by the Psalms in Indian, in 1661 by the Indian New Testament, and in 1663 by the whole Bible in the Indian tongue. This was the first Bible printed in America.

Early Publishers.— In New York city the original book publisher was William Bradford, who became official printer in 1693, for "40 pounds a year and half the benefit of his printing, besides what served the public." In 1694 he issued the "Laws of the Colony," the first bound book published in New York. In 1738, Christopher Sauer established a publishing house at Germantown, Pa., and issued the first German Bible printed in America in 1743. The firm of Little, Brown & Company was estab-

lished in 1784 in Boston while in the following year in Philadelphia, Lea Brothers & Company and Henry Baird & Company began business. It was also in 1785 that S. E. Bridgeman & Company began publishing books at Northampton, Mass. The existing house of J. B. Lippincott & Company was established in Philadelphia in 1798. The firm of Harper & Brother began business in New York in 1817. From this date the publishing business had a rapid growth, among the firms established being the following in New York: Baker, Voorhis & Company, 1820; D. Appleton & Company, 1825; D. Van Nostrand, 1830; Ivison & Company, 1831; John Wiley & Sons, 1832; John F. Trow, 1835; A. S. Barnes & Company, 1838. In other cities the early firms included the following: Cincinnati, O., U. P. James, 1831; Springfield, Mass., G. & C. Merriam Company, 1831; Louisville, Ky., John P. Morton, 1825; Richmond, Va., J. W. Randolph Company, 1831; Mobile, Ala., G. H. Randall, 1831; Montgomery, Ala., Joel White & Company, 1833; Lancaster, Pa., John Baer's Sons, 1817.

The Early Book Trade.— As an adjunct to publishing, the selling of books originated in Boston as early as 1652, when Hezekiah Usher opened the first shop. Many colonial booksellers printed and published their wares. Benjamin Franklin (q.v.) was among the early book printers. In 1732, Richard Fry, an Englishman and bookseller of Boston, advertised: "Whereas it has been the common method of the most curious merchants of Boston to procure their books from London, this is to acquaint these gentlemen that I, the said Fry, will sell all sorts of accompt books, done after the most acute manner, for 20 per cent cheaper than they can have them from London. * * * For the pleasing entertainment of the polite parts of mankind, I have printed the most beautiful poems of Stephen Duck, the famous Wiltshire poet. It is a full demonstration to me that the people of New England have a fine taste for good sense and polite learning, having already sold 1,200 of these poems." The first convention of booksellers for the regulation of trade seems to have been held in Boston, 1724; it was for the special purpose of increasing the prices of certain works. Toward the close of the century bookselling began to take rank among the most considerable commercial pursuits, though it then only foreshadowed its present comparative importance. Works of standard character, involving large expenditures, were undertaken by publishers, who, in such cases, usually subscribed together as a guarantee for the printer's outlay. The trade was conducted upon established principles, and innovators were held in poor esteem. All these usages were, however, disturbed by competition, and after the publication of the Waverly novels, of which rival editions were issued, the individual members of the trade acted more independently of each other, and their customs afterward partook of a less narrow spirit. The American company of booksellers was founded in 1801. Books were formerly sold in sheets, to be bound as purchasers might desire, a practice which no longer obtains. The universal diffusion of education in America, and the inquiring mental character of its people, not only increased the circulation of books but reduced their price, and the old-fashioned veneration which literary works had once inspired experienced no little modification. Externals were of small consequence to the great body of readers, and works were purchased not so much for preservation as for immediate reading.

Statistics.— From 1825 to 1840 the number of American publications show an aggregate of 1,115. Of these 623 were original and 492 were reprints from foreign works. The population of the United States in that year was about 17,000,000. In 1853, 733 new works were published in the United States, of which 278 were reprints of English works, 35 were translations of foreign authors, and the remainder were original American works. The population of the United States had reached about 25,000,000, an increase of 50 per cent compared with 1840. The original American works published in 1853, compared with the 15 years ending in 1840, show an increase of about 800 per cent in less than 20 years. In other words, the original American publications of the book trade seem to have advanced about 15 times as fast as the population. In 1880, with a population of 50,000,000, the new books published during that year amounted to about 2,000 — nearly three times more than in 1853, whereas the population had only doubled. The total number of new books published in each year, according to the records of the "Publishers' Weekly" from 1881 to 1903 inclusive, were as follows:

NEW BOOKS PUBLISHED.

1881	2,991	1893	5,134
1882	3,472	1894	4,484
1883	3,481	1895	5,469
1884	4,038	1896	5,703
1885	4,030	1897	4,928
1886	4,776	1898	4,886
1887	4,437	1899	[illegible]
1888	4,631	1900	[illegible]
1889	4,014	1901	8,141
1890	4,559	1902	7,833
1891	4,665	1903	7,865
1892	4,862		

Included in these figures are different editions of the same book issued by different publishers. The total for 1903, of 7,865 books includes 2,072 new editions. Of the new books, 5,621 were by American, 1,356 by English and other foreign authors. The 888 books required to make up the total of 7,865, were imported "in sheets," i. e., they were printed abroad, and bound in this country. Fiction leads, with 977 American and 483 foreign books. Law comes next with 605 titles, all but three American; education holds third place, (627 titles) and religion and theology fourth, with 513 titles. The output for 1902 and 1903 may be compared as follows:

	1902.	1903.
Fiction, American	903	977
Fiction, Foreign	818	483
Law	622	605
Education	408	627
Theology	433	513

A more detailed classification of the output of books in the United States during a single

year will be found in the report for 1902, as follows:

BOOK PUBLICATIONS FOR 1902.

Classes	Copyright books by American authors including new editions.	Books by English and other foreign authors including new editions.	Books in English imported in editions.
Fiction	903	818	76
Law	622	2	16
Juvenile	388	39	87
Education	408	108	63
Theology and religion	433	78	128
Political and social science	223	8	40
Biography, correspondence	253	37	95
History	178	59	64
Poetry and drama	220	130	49
Literature and collected works	311	136	96
Physical and math. science	259	19	80
Descrip. geog., travel	267	13	83
Medicine and hygiene	243	30	26
Fine arts, illust. gift books	110	47	60
Useful arts	126	6	33
Philosophy	62	26	15
Domestic and rural	73	9	14
Sports and amusements	46	8	7
Humor and satire	49	3	2
Works of reference	98	2	11
Totals	5,210	1,578	1,045
			1,578
			5,210
Grand total			7,833

Popular Books.— In 1903 there were 1,700 book publishers in the United States. While Boston and Philadelphia remain true to their earlier reputations as leading book centres, New York has become the largest book mart and the leading factor in the manufacture of books. Chicago too has assumed an important place in the book trade, while some hundreds of books are published annually in Cincinnati, San Francisco, Cleveland, and other smaller cities. The majority of American books are published by 100 firms in New York, Boston, Chicago, and Philadelphia. During 1902 and 1903 the historical novels enjoyed widespread popularity, and nine books of this class circulated to the extent of 1,400,000 copies. This enormous output, however, did not lessen the sale of older and more standard books. These were largely reprints. A popular work 75 years after its first publication is often found to have been reprinted 20 times by as many different publishers. Of the world's great standards, hundreds, and in some cases thousands, of editions have appeared. There is, nevertheless, a distinction to be made between the manufacturer of books who takes old works and reprints them, and the publisher who issues entirely fresh and original matter. Among early successful books Mrs. Stowe's "Uncle Tom's Cabin" had a phenomenal sale, 500,000 copies being sold in less than five years in the United States, and by April 1852 more than 1,000,000 had been reprinted in Great Britain. Of Longfellow's poems, without taking into account unauthorized English reprints, the American sales in 1839-57 amounted to 325,550; from the latter date till 1901, 220,000.

School Books.— No small factor in bookmaking during the 19th century was the phenomenal production of school and college textbooks. In fact, the publication of educational works has increased steadily. In 1902 the reports showed a list of 433 educational works, while in 1903 this was increased to 607. This is illustrative of the remarkable growth in schoolbook publishing. Of books for use in the public schools editions of 500,000 copies, intended for one year's consumption, are not an unusual event. Messrs. D. Appleton & Company for many years sold over 1,000,000 copies of Webster's "Speller" every year; and W. B. Smith & Company, of Cincinnati, Ohio, sold over 1,000,000 copies of the Eclectic Series during each year. The electrotype plates of schoolbooks, Bibles, prayer-books, and hymn-books, are very rarely changed, and enormous quantities are sold every year.

Miscellaneous Books.— In the United States many encyclopedias, dictionaries, the complete works of standard authors in definitive editions, anthologies of literature, etc., are sold by subscription; and the initial expense of such books being enormous, before a single copy of the book is made, the sales must be enormous also. Then there are many "books which are not books" — such as city directories, which are usually published by a company devoted exclusively to the publication of this one book; State directories, list of dealers in each business, and commercial agency reports (each of these agencies makes four revised editions of its books each year, each book measuring about 11x13 inches, and containing about 2,500 pages of matter in close print. There are also innumerable genealogies, indexes, catalogues, together with many other productions which are truly books, but which cannot be called literature.

Commercial Value.— In the publishing of books the following are the items of outlay which need to be taken into account: Copyright, paper, typesetting, author's corrections, electrotyping, press work, binding, advertising. Publishing means a great deal more than merely printing and binding a book. It means putting it where it is likely to sell. The machinery of distribution, which means the method of getting books finally into the hands of readers through the various middlemen, is vastly important. The manufacture of a book now demands the assistance of various branches of mechanical skill. Besides the paper-maker, the type-founder, and the printer, to whom it gives a large proportion of employment, it engages, exclusively, the bookbinder. Its material form has, till the present era of cheap publications, always borne a commercial value extravagantly disproportionate to its matter.

Copyright.— A common arrangement between the American author and publisher is a payment of 10 per cent royalty on the retail price of all sales; sometimes a cash sum is paid, and the publisher secures the copyright, which is granted for 28 years, subject to renewal by the author, his widow, or children for other 14 years. A condition is that a copy of a title-page must be registered with the librarian of Congress, and two copies of the book lodged there within ten days of publication. The entry fees are 50 cents for an American author, $1.00

AMOUNT OF MATERIAL CONSUMED ANNUALLY IN THE UNITED STATES IN THE MANUFACTURE OF BOOKS AND PERIODICALS.

for a foreigner, and 50 cents additional for a certificate of record. A copy of any new edition must also be sent to the librarian. (See COPYRIGHT.) By the provisions of the International Copyright Act (1886), a foreign author's rights are protected in Great Britain, Belgium, France, Germany, Hayti, Italy, Spain, Switzerland, and Tunis. Colonial authors can also secure copyright without publication in the United Kingdom, and a work copyright in the United Kingdom is copyright in Canada. American cheap reprints of British books are admitted to Canada subject to a customs duty of 12½ per cent, to be paid over to the British author, but the returns from this source have been very small.

Bookbinding.— Since 1885, in the book-making industry, many improvements have been made in wire-stitching machines. One of these machines will stitch anything from two sheets to a book two inches thick, and with several of them either round or flat wire may be used. There has also been introduced a noteworthy combination folding and wire-stitching machine, which, by a continuous and automatic operation, takes the sheets from the feeders, and folds, gathers, collates, covers, and wire-stitches them. Paper-cutting machines have been improved by the introduction of automatic clamps, indicators, and gauges. The invention of a steam rounding and backing machine has increased the capacity of from 500 to 1,000 books per day to a capacity of from 5,000 to 6,000 in the same time. The latest case-making machine feeds itself from a roll of cloth which it automatically cuts into pieces of proper size for use. The cloth is first covered with glue by contact with a cylinder revolving in a pot of glue. It is then cut by the machine and nicked in corner sections; boards are supplied from a holder and a back lining from a roll, both receptacles forming part of the machine. This process completed, the nearly finished product drops a little, the cloth is folded over the boards and back lining, and the binding, after passing through a case smoother, is delivered in a finished state. Among other inventions are a casting-in machine, for putting the body of a book into its cover, and a gathering machine. This latter invention promises important developments in economy.

Book Plates.— About the year 1804 the art of stereotyping was invented in England, and in a few years was introduced into this country. With the type-printed book under the old conditions a publisher did not dare print a large number of copies of any book unless he believed it would have a quick sale. Books were bulky, and took up too much space. Consequently, the types for a first edition were distributed when they left the press; then had to be reset with renewed chances of error in the second edition. Resetting for two or more editions added largely to the cost of the book and limited its supply. The process of stereotyping first used, known as the plaster process, served book printers for about 50 years. The practice of the art was brought to New York by David Bruce in 1813, but the first book stereotypes in America was the «Westminster Catechism.» made by J. Watts & Co. of New York in June of the same year. For the printing of books, all methods of stereotyping have been superseded by electrotyping, which was experimentally tried in New York as early as 1841, and was in general use before 1855.

Book Imports.— The summary of imports of books and other printed matter for 1902 and 1903 shows the following:

(FREE OF DUTY.)

Imported from	1902	1903
United Kingdom	$1,057,909	$1,327,75c
France	174,326	167,965
Germany	615,140	623,889
Other Europe	379,047	264,037
British North America	42,091	33,563
Other Countries	20,379	21,658
Totals	$2,288,802	$2,438,862

(DUTIABLE.)

Imported from	1902	1903
United Kingdom	$1,112,017	$1,181,049
France	76,201	82,800
Germany	261,464	307,961
Other Europe	83,059	96,381
British North America	48,228	46,127
China	3,308	3,728
Japan	15,256	21,117
Other Countries	5,869	5,266
Totals	$1,605,402	$1,744,159

The total imports for 1903 amounted to $4,183,021 as against $3,894,204 for 1902.

Book Exports.— The books and other printed matter of domestic manufacture exported from the United States during 1902 and 1903 represent the following:

Countries to Which Exported	1902	1903
United Kingdom	$1,094,341	$1,102,248
Belgium	25,184	27,251
France	70,143	49,852
Germany	199,060	193,125
Italy	17,317	27,038
Netherlands	11,695	10,735
Other Europe	35,867	33,294
British North America	1,362,903	1,557,331
Central American States and British Honduras	19,475	15,978
Mexico	220,129	152,409
Cuba	70,134	80,864
Other West Indies and Bermuda	31,517	32,316
Argentina	35,232	40,011
Brazil	30,927	40,199
Chili	44,488	37,582
Colombia	36,612	10,237
Venezuela	19,700	3,499
Other South America	47,115	61,951
Chinese Empire	30,740	25,750
British East Indies	29,796	22,826
Japan	59,897	50,083
British Australasia	239,677	191,031
Philippine Islands	140,881	52,159
Other Asia and Oceanica	23,258	20,698
British Africa	109,293	50,164
All other Africa	11,465	9,979
Other Countries	....	34
Totals	$4,016,845	$3,911,634

During the decade 1894 to 1904 the only striking change recorded in the book-publishing trade was the enormous and phenomenal circulation of a dozen popular novels. During this

period the advance in good taste and in artistic beauty of product was a marked characteristic of the industry. Fashions in bindings changed annually, but a widening range of materials and patterns, more daring use of designs and inks, and the invention and general use of automatic binding machinery supplemented improvements in printing, permitting lower prices for books and promoting phenomenal sales. It is a significant coincidence that the decade which witnessed extraordinary advance in all details of mechanical productions in this industry should be characterized also by the most noteworthy advance in the good taste and appreciation of the general public.

H. H. McClure,
Of McClure, Phillips & Co., New York.

American Quarrying. See Quarrying.

American Railroads. The first railroads in the United States were built to carry stone, gravel, anthracite coal, and other heavy materials. These of necessity were short. One was built on Beacon Hill in Boston, in 1807; one in Delaware County, Pa., in 1809; and one at Bear Creek Furnace, Armstrong County, Pa., in 1818. Other short roads were simultaneously constructed, all having tracks composed of wooden rails. In 1812, Col, John Stevens, of Hoboken, N. J., issued a pamphlet stating "that trains of carriages would be drawn on railways at 20 or 30 miles an hour," and further said, "I can see nothing to hinder a steam carriage from moving on these rails with a velocity of 100 miles an hour." This was a daring prophecy; but in 1827 the Delaware & Hudson Canal Co. began the construction of the Carbondale R.R., extending from Hohendale, Pa., to Carbondale, a distance of 27 miles. Horses were the motive power for drawing the cars which were used in transporting coal from the mines to the canal. In 1828 this company sent Horatio Allen, a machinist and civil engineer, to England to purchase iron rails, and to order 3 locomotives of such pattern as he might determine upon after his arrival in England. The first of these made its trial trip on 9 Aug. 1829, and was the first locomotive ever run in America. Mr. Allen ran the engine himself, and would permit no one else on it, as he considered the risk of life and limb too great.

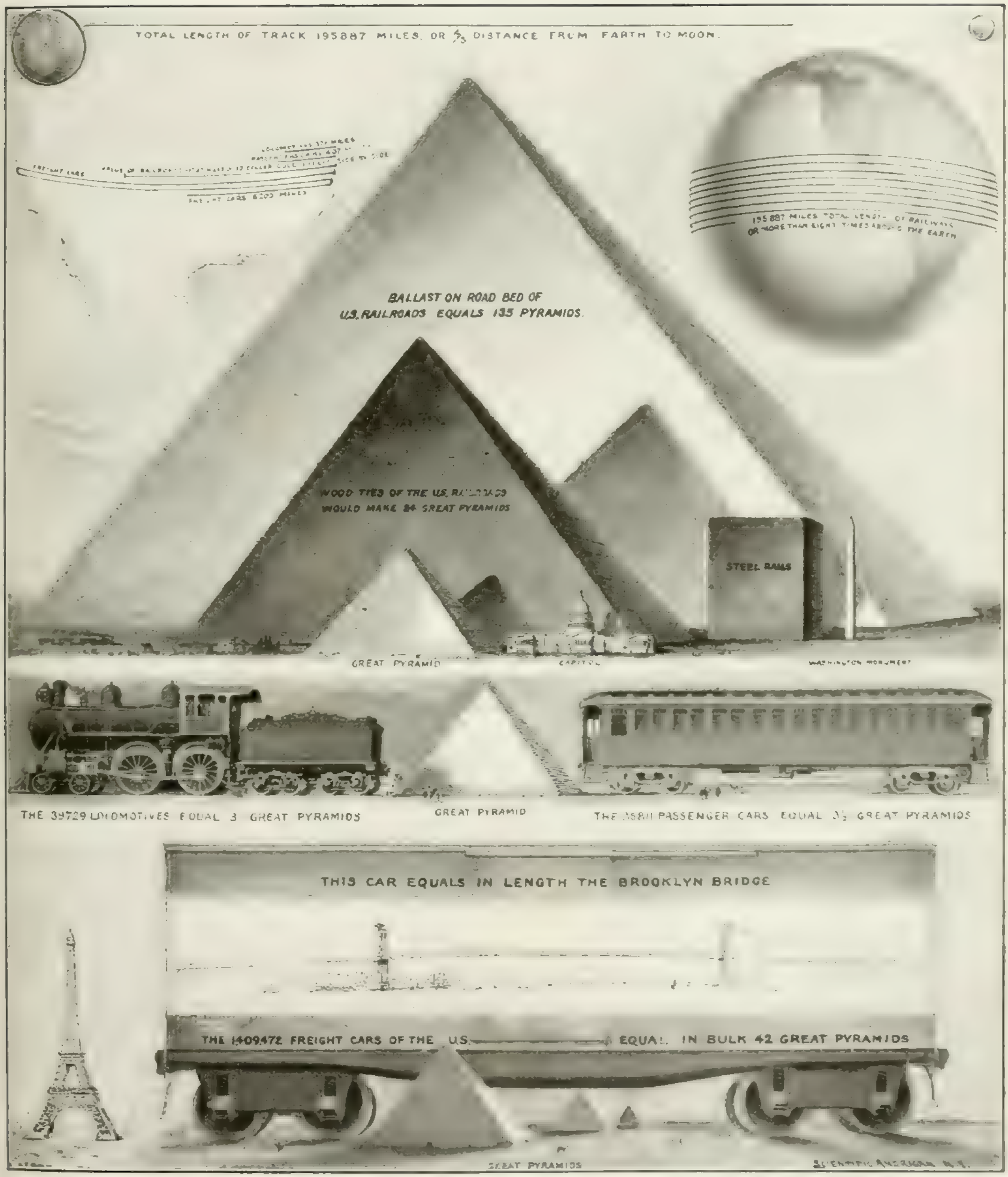
The Baltimore & Ohio R.R., the first undertaking to transport passengers, was projected in 1828, constructed in 1829, and opened for business from Baltimore to Ellicott Mills, 15 miles, in May, 1830. Horses were used, and where the change of teams was made, gave rise to the well-known relay station 9 miles from Baltimore. In 1830, Peter Cooper built a locomotive, the first ever constructed in the United States, and congratulated himself that he made better time than the horses on the Baltimore & Ohio R.R. This engine weighed less than a ton, the boiler was about the size of a flour barrel, and the flues were made of gun barrels.

In 1830 there were but 23 miles of railroad in use. During the succeeding 10 years the total mileage reached 2,818. The line from Albany to Schenectady, 17 miles, was opened in 1831. Five years later Albany and Utica had rail connection, and in 1842, Buffalo was reached. In the meantime lines had been built from New York and Boston to Albany, so that the then East and West were in easy communication by way of the railroads and the Great Lakes. In the year 1850, the length of the railroads in the United States aggregated 9,021 miles; in 1860, 30,635 miles; in 1870, 52,914 miles; in 1880, 93,296 miles; in 1890, 163,597 miles; in 1900, 193,346 miles. The present mileage of the railroad systems of the United States, in excess of 200,000, only partially indicates their magnitude, when it is remembered that the present total value of railroad assets ($13,000,000,000) is about one-seventh of the total present wealth of the United States ($90,000,000,000).

There are about 1,000 operating railroad companies in the United States; but the railroad system of the United States is conveniently divided into 7 groups, each group occupying a nearly distinct section of the country, the basis of the grouping being found in differences in production, density of population, and various social and ecomonic conditions prevailing in the 7 sections of the country. In each of these sections there is considerable unity in the operation and ownership of the railroad systems. These territorial groups are as follows: (1) The New England States; (2) the region west of New England and the middle Atlantic seaboard, north of the Ohio and James rivers, and east of Chicago and Saint Louis (trunk line territory); (3) the section south of the Ohio and James rivers and east of the Mississippi (southern territory); (4) the region west and north of Chicago and Saint Louis, including the chief grain-raising States of the United States (granger territory); (5) south and west of Saint Louis (southwestern territory); (6) west of the granger and southwestern territories (trans-continental or Pacific lines); (7) a subdivision of lines within the trunk-line territory whose business consists chiefly of transporting anthracite coal from the Pennsylvania mines to the seaboard.

This grouping of the American railroads into 7 systems, based upon physical differences in territory and economic conditions, is not entirely satisfactory, as it gives little or no information regarding ownership and management. A grouping along this line would be as follows: (1) The Boston & Maine, 3,283 miles; (2) New York, New Haven & Hartford, 2,027 miles; (3) the Vanderbilt roads, 20,798 miles; (4) the Pennsylvania system, 19,301 miles; (5) the Philadelphia & Reading system, 2,145 miles; (6) Morgan roads, 11,229 miles; (7) Morgan & Atlantic Coast Line Company roads, 10,071 miles; (8) Illinois Central, 5,380 miles; (9) Seaboard Air Line, 2,611 miles; (10) Gould roads, 15,504 miles; (11) Moore roads 13,003 miles; (12) Chicago, Milwaukee & Saint Paul, 6,604 miles; (13) Chicago Great Western, 956 miles; (14) Hawley roads, 2,376 miles; (15) Wisconsin Central, 978 miles; (16) Harriman roads, 16,468 miles; (17) Morgan-Hill roads, 24,711 miles; (18) Atchison, Topeka & Santa Fé, 7,876 miles. This classification, subject to constant change by transfers of ownership, shows that four-fifths of the railroad mileage of the United States is now in the hands of a few large interests and capitalists, between whom there is developing a community of interest or harmony of action that is restraining competition in rate-making.

The United States government has sought to supervise or regulate the entire business of rail transportation in order to establish and maintain equitable relations between the carriers and



RAILWAY STATISTICS OF THE UNITED STATES.

the people served. This result cannot be attained solely by statutory prohibitions. In America, laws to be enforced must give expression to public opinion and in order to make unjust discriminations impossible, the public must declare that it is as much a crime for public carriers to deny to one individual or community advantages to which they are justly entitled, as it would be for the government to show favors to some citizens, and discriminate against others. The problem is a continuing one, the specific necessity for government regulation varying from time to time. In 1870 it was necessary to secure cheaper rates to the seaboard for the agricultural products of the Central States; during the period from 1870 to 1890 it was necessary to adjust the rates charged at small local towns and large cities; at the present time it is imperatively necessary to secure relatively reasonable rates for rival areas of production and for rival economic interests in the same area of production. In the last few years new ideas have led to the betterment of railroad management and operation and the railroad personnel has been educated to a high standard. The system of to-day is a development resulting from 75 years of experience. From the first crude plant by gradual stages has been evolved the modern economical transportation machine of to-day. From the first crude rate sheet has been evolved the present successful, if complicated scheme of charges, successful because it moves the traffic to the satisfaction of the shippers, the benefit of the country at large, and produces a profit to the corporation owning the properties. See RAILWAY SYSTEMS, AMERICAN.

EDWARD S. FARROW,
Consulting Railroad and Mining Engineer.

American Republics, Bureau of. The Pan-American Congress held in Washington in 1889, though ostensibly convened merely to consider arbitration and the improvement of commerce between the republics of the western hemisphere, had a much broader object in view: to express in practical form the solidarity of American interests, and devise means to protect them. Believing that a closer union between us is possible only through confidence born of closer intimacy, the Congress created the International Union of American Republics and organized the Bureau of American Republics (with a supervisory International Executive Committee) to effect that purpose.

The Bureau's original function of publishing tariff data, port regulations, trade statistics, etc., was soon extended to the diffusion of all sorts of exact knowledge concerning the American republics, showing their natural solidarity and mutual protective necessities. To this end it publishes a monthly bulletin in English, Spanish, Portuguese, and French, now in its 11th volume; handbooks to the Central and South American states; their tariff, immigration, and other laws of general interest, and a great variety of information otherwise inaccessible on their commerce, industries, and general conditions; also an alphabetical code of commercial nomenclature in parallel English, Spanish, and Portuguese columns comprising over 50,000 dutiable commodies, for the use of customs and consular officers and shippers. In 1000 it began compiling from the best sources special large-scale maps of various republics, containing all economic data, lines of rail and wire, mines, areas of cultivation, etc. As a further instrument it has built up a library of 'American' of nearly 10,000 volumes, and a valuable collection of maps and photographs, in the subject-catalogues of which are noted all the works and articles on America, and cognate maps, in Washington libraries. It also receives all official documents published by American countries.

American Revolution. See UNITED STATES — AMERICAN REVOLUTION.

American River, in north central California, is formed by the union of its northern and southern forks near the western boundary of the county of El Dorado, whence it flows southwest between the counties of Placer and Sacramento and falls into Sacramento River near the city of Sacramento. For about six miles it has been rendered navigable for small steamers. The north fork, considered by some as the true American River, rises among the hills at the base of the Sierra Nevada, flows west-southwest, forming the boundaries between Placer and El Dorado counties for 100 miles, and unites with the south fork 30 miles above the city of Sacramento. The south fork flows from Bonpland Lake through El Dorado County, and forms part of the division between the counties of Sacramento and El Dorado.

American Scenic and Historic Preservation Society, a national organization established in 1895 for the protection of American scenery and the preservation of American landmarks.

American Schools of Law. See LAW, AMERICAN SCHOOLS OF.

American Shipbuilding. The inception and development of this industry in America is primarily due to the enterprise of the early colonists of New England, who thus wove into the fabric of a history of isolated colonization, replete with incidents of hardships and self-sacrifice, the magical thread of commerce which connected them with the outside world.

The first effort was inspired by the desire of the members of the Church of England Colony, established at Sagadahoc, Maine, in 1607, to return to the mother country after the discouraging experiences of a hard New England winter. Thus, at the mouth of the Kennebec River, near one of the most important shipyards of the present time, the keel of the first American-built ship was laid, a little two-masted vessel about 60 feet long, which was named the "Virginia." From that time up to 1630, a few small vessels were built for various special purposes; but, shipbuilding did not assume the dignity of an industry until the trade of Brazil and the Dutch West Indies, monopolized by the Dutch West India Company, was thrown open to the colonists of New Amsterdam. This gave an impetus that was felt all along the coast. Boston and Salem builders produced several vessels ranging in size from 150 to 300 tons, which engaged in profitable trade with Spanish ports; while the shipping owned in the port of New Amsterdam increased in less than 20 years, from a fleet of 15 or 20 small vessels, to one of 60 good-sized ships, and over 100 sloops, engaged in both foreign and coast-wise trade, and from this time up to the middle of the 18th century, the industry grew steadily under impulses from one source or another. New York (New Amsterdam) was engaged in an extensive ex-

porting trade of flour and biscuits, while Massachusetts employed at least 1,000 vessels in the development of her fishing trade. The period from 1750–70 may, therefore, be considered the first epoch of the industry. In the latter year, the American vessels represented a tonnage of about 400,000, approximately one-third that of Great Britain, and nearly one-half of this amount was turned out of the shipyards of Massachusetts. By this time, however, Philadelphia had become a big center of activity. It was the most accessible port to the West Indies, our principal market at that time, and consequently turned out a large proportion of the 400 or more vessels built annually in the country.

The beginning of the Revolution, therefore, found the industry in a most flourishing condition, and although during the following war the merchant marine and the fishing and whaling fleets of the country were practically annihilated, the demand for privateers and vessels of war served to sustain the effort until the close of hostilities allowed its redevelopment, so that at the close of the 18th century, the tonnage of American shipping amounted to nearly 700,000. From 1800 to 1812, however, the commercial hostility of Great Britain practically manifested by the exclusion of the West Indian trade from the Americans, the seizure and confiscation of their ships, and the detention of a large number of them in various ports, for alleged evasions of British laws, prevented the much greater development probable under different conditions.

The War of 1812 gave the finishing stroke and caused a sharp decline in the industry until 1815, when a new impulse was given by a rapidly increasing coast-wise trade, and the demand for a larger number of packets in the line of transatlantic passenger transportation, due to the increased emigration from Europe to America at the close of the war. The annual tonnage increased steadily from about 50,000 in 1820, to about 600,000 in 1855. Several packet lines were established between New York, Philadelphia, and Boston and British and French and other European ports, and also a great many lines touching at the important ports along the coast from Portland, Maine, to New Orleans, La., and the gulf ports of South America and Mexico. The vessels were built on speedy lines; had roomy accommodations for passengers; ranged in size from 500 to 1,000 tons, and marked one of the most prosperous periods of the industry. About the year 1840, English steamers were placed in competition with those sailing packets, and aided by their superior carrying capacity, slowly but surely supplanted them in the course of a few years.

The vessels thus thrown out of the packet line service were converted into freighters, and caused a slight decline in the industry, which, however, was relieved about the year 1835 by the demand for large and swift-sailing vessels for the Chinese tea trade. This inaugurated the era of famous clipper ships, the construction of which being still further stimulated by the Californian gold discoveries of '49, extended the period of their maximum usefulness to the beginning of the Civil War in 1860.

These vessels represented the highest skill of the American naval architect. The shipyards of New York, Boston, and Philadelphia built them in sizes ranging from 750 to 2,400 tons.

Their lines were laid down sharp, and under their lofty masts and enormous spreads of canvas, they made the best records ever made by sailing vessels, and the tonnage of American shipping very nearly equalled that of Great Britain.

The Civil War, however, terminated their career. English-built Confederate privateers, running under steam, swept the seas, and American ships representing hundred of thousands of tonnage were either destroyed or were compelled to seek protection under foreign flags.

At the end of that war, America was no longer a maritime nation. The events of that war had developed new principles and new methods of shipbuilding. The advantages to be derived from the use of iron as a material of construction had been demonstrated beyond a doubt sometime previously, and while the industries of America were paralyzed by the internecine conflict, the English shipyards had taken full advantage of their opportunity, and backed by governmental subsidies, had re-established Great Britain's old-time supremacy of the sea.

From 1860 to 1882, the stagnation in the American effort was extreme. In 1855 the number of vessels turned out of the American yards amounted to 381 ships and barks, and 126 brigs, while in 1885 only 11 ships and barks left the ways.

The seriousness of the situation was recognized by the American capitalists as early as 1870. It was plain that a great producing nation could not be truly great, or develop itself to an extent commensurate with its vast natural resources, without the possession of an ample merchant marine, and they decided to revive the shipbuilding industry. Accordingly, 4 steamers, the Ohio, Indiana, Pennsylvania, and Illinois, were built by the Cramp Company, of Philadelphia, for the transatlantic trade. They were unquestionably as fine as any vessels of their time, but they were unable to compete with the British vessels which operated under larger subsidies.

It was apparent that adequate governmental subsidies were necessary to sustain the effort of private capitalists, and that the growth of the British merchant marine was directly due to such liberal assistance.

Therefore, steps were taken by the various steamship companies, to obtain large concessions from the government, and the Pacific Mail Steamship Company, which was already receiving a subsidy of $500,000 per annum, for a monthly mail service to Japan and China, offered to double the service for an additional $500,000 per annum. A bill granting this subsidy was passed by Congress in 1873, but disclosures confirming the fact that a million dollars had been spent by the company to influence a favorable vote in Congress, and the subsequent failure of the company to comply with the requirements of the bill, led to the abrogation of the new contract by the government. The total subsidies paid to the Pacific Mail Company during its 10 years of contract service amounted to $4,583,000; but, as no increase in the Oriental trade of the United States could be traced directly to the influence of a subsidized mail service, the resultant effect was a steady decline of the merchant marine.

Another attempt to ameliorate these conditions and affect a revival was made when the steamships New York and Paris, of the Inter-

THE "MASSACHUSETTS."

ONE OF THE LARGEST CARGO CARRIERS EVER BUILT FOR THE ATLANTIC TRADE IN AMERICAN SHIPYARDS.

THE MINNESOTA, THE LARGEST VESSEL BUILT IN AMERICA

Length, 630 feet; Breadth, 73 feet 6 inches; Molded Depth, 56 feet; Displacement on 33 feet draft, 33,000 tons; Speed, 14 knots.

national Navigation Company's line, were admitted to an American register on the condition that two other vessels, their equal in every particular, should be built in American ship yards. The government granted to these vessels a payment of $4 a mile for carrying the mails upon the condition that they were capable of maintaining a sustained speed of 20 knots an hour.

The result of this agreement was the construction of the steamships St. Louis and St. Paul in 1895, and the effective application of the system of mail-carrying contracts.

At the present time the subsidies for carrying the mails are defined on a mileage basis. It amounts to $4 per mile for first class steamers; $2 a mile for second class steamers; $1 a mile for third class steamers; and 66 2/3 cents per mile for fourth class steamers. In addition to this the post-office department pays American mail steamships $1.60 a pound for first class matter, and 8 cents a pound for all matter below that grade.

The first general subsidy measure designed to establish a system of direct navigation bounties was introduced in the United States Senate in 1898, and was passed by that legislative body in March, 1902. It consisted of four titles: "Ocean mail steamers," "general subsidy," "deep-sea fisheries," and "general provisions." Payments for carrying mails were based upon speed and tonnage instead of mileage, and the ocean mail steamers were divided into seven classes on this basis. For 100 miles sailed, steamers of the first class received 2.7 cents per gross ton; those of the second class, 2.5 cents; third class, 2.3 cents; fourth class, 2.1 cents; fifth class, 1.9 cents; sixth class, 1.7 cents; and those of the seventh class, 1.5 cents. The section entitled "general subsidy," provided for the payment of a bounty of 1 cent per gross ton for every 100 nautical miles sailed, to all vessels not receiving the mail subsidy, and was intended to offset the alleged greater cost of construction, and the greater expenses incurred in the navigation of American vessels. Under the title "deep-sea fisheries," provision was made to grant a bounty of $2 per gross ton per annum on American vessels engaged for at least three months in deep-sea fishing, and $1 per month to each sailor employed on such vessels. This measure was brought before the House during the last session of the Fifty-seventh Congress; but was adversely reported upon by the committee in charge and failed to become a law.

The period of great internal development of the country is practically at an end. The great railroad systems are practically built, and the vast accumulations of wealth in the country are seeking investment. If it is demonstrable that the margin of profits on present investments can be enhanced or even prevented from declining by investments in ships, such investments will be made and the industry will grow steadily but surely under the normal conditions of trade.

In this connection it is interesting to note the evolution of that distinctly American type of vessel, the "schooner." From a handy two-masted craft of about 100 or 150 tons, extremely serviceable in the coast-wise trade, it has been developed to the mammoth "seven master" of the Thomas W. Lawson type. The development of the larger schooners appears to have been along the lines of maximum carrying capacity at the minimum operative expense. Yet, since the building of the Thomas W. Lawson, in 1902, no effort has been made to duplicate her, although she has made several fast trips from Chesapeake Bay to Boston, and they were undoubtedly remunerative.

In fact only one six-masted schooner is under construction at the present time (1905), and no seven-masted schooner is even under contemplation.

The reasons for this are quite clear. Her extreme length of 395 feet makes her unavailable for the general coasting trade, as she is unable to load for crooked river ports, and is a misfit at many of the wharves at other places.

It is, therefore, apparent that in the matter of size the sailing vessel has reached her limit, and is already showing a tendency to go back to the less unwieldy five-master, well adapted, not only to the coast-wise trade, but also to the trade with foreign countries, involving extended deep-sea voyages.

For detailed information relative to the development of the American shipbuilding industry during the last decade in special lines, consult the articles under the titles NAVAL CONSTRUCTION; SAILING VESSELS; SHIP; SHIPBUILDING; and STEAM VESSELS, in this encyclopædia.

American Silkworm. See SILKWORM.

American Social Science Association. See SOCIAL SCIENCE ASSOCIATION, AMERICAN.

American Society of Civil Engineers, an association organized 5 Nov. 1852, in the City of New York, its object being the professional improvement of its members, the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches, and of architecture, and the establishment of a central point of reference and union for its members. Among the means to be employed for attaining these ends are periodical meetings for the reading of professional papers, and the discussion of scientific subjects, the foundation of a library, the collection of maps, drawings and models, and the publication of such parts of the proceedings as may be deemed expedient.

The early life of the Society was a struggle for existence and it was not until 1867 that the organization had a permanent headquarters, and began its work in earnest. The first publication was the address of President James P. Kirkwood, delivered 4 Dec. 1867, and printed in Vol. I. of 'Transactions' bearing date of 1872. The first Annual Convention was held in New York 16 June 1869, 55 members being present. The second and third conventions were also held in New York, but the fourth was held in Chicago and the annual conventions are now held at widely separated points. In 1869 the membership of the Society was 160; the membership in 1904 is over 3,200. The society has a splendid library of over 50,000 volumes, thoroughly classified and indexed and which is kept up to date by new additions. A monthly publication of 'Proceedings' is issued in which are printed the professional papers in advance of their presentation at the semi-monthly meetings. These papers with all the discussion to which they give rise, are subsequently printed in 'Transactions,' two and sometimes three volumes of which are issued an-

nually. The last report of the Secretary shows the assets of the Society to be over $235,000.

The organization is in no sense a local one, and it has never had any subsidiary branches or been affiliated with other organizations. Its membership is made up of practitioners engaged in all branches of Civil Engineering, the broadest interpretation of that term being used. From the beginning, admission to its privileges has been dependent solely upon professional experience and personal character.

That the Society is beneficial to the profession is evidenced by the eagerness with which membership in it is sought. The reasons for this are apparent, inasmuch as among its objects are to assist the young engineer professionally during the earlier years of his career, and, when he has proved himself worthy, to stamp him as one qualified to direct "the great sources of Power in Nature for the use and convenience of Man."

That its influence is far-reaching is shown by the fact that it has members in 51 of the 54 subdivisions of the United States, as well as in 31 foreign countries. This foreign membership constitutes 9½ per cent of the total list.

CHARLES WARREN HUNT,
Secretary of the Society.

American Society of Mechanical Engineers, a professional organization composed of engineers practising principally in the department of generation, distribution and utilization of mechanical power. It is one of four organizations of engineers, national in its character and with a considerable foreign membership also, which exists for the purpose of the reading and discussion and publication of papers on engineering subjects and for the advancement of the profession of engineering in any direction within its scope.

The society was formed in 1880 by a group of persons in and near New York city, who recognized that the existing societies of mining and civil engineers did not naturally and instinctively offer a scope for the developing strength of mechanical engineering in the United States. Its first meeting was held in New York city in the autumn of 1880. Since that two meetings have been held each year; the annual meeting in the city of New York, and the other meeting in various cities of the Union; meetings have fallen in Boston, Providence, Philadelphia, Altoona, Pittsburg, Cleveland, Nashville, Richmond, St. Louis, Chicago, and San Francisco.

These meetings last three or four days and are always made the occasion of visits to important engineering enterprises in the city which is entertaining the society. Usually from 15 to 20 papers are read and discussed at each of these meetings and the papers with their discussions are issued to all members in the form of an annual volume, averaging a thousand pages and copiously illustrated. These volumes which are designated 'Transactions' are an accumulation of most valuable professional literature, results of tests and experiments, researches into new fields and are filled with recorded data of observation.

The society was incorporated as a national organization under the laws of New York State in 1881, and has maintained its executive offices in New York city. For seven or eight years its headquarters were in office buildings in the business district, but in 1889 the movement was started of having its library of professional literature open in the evenings and for this purpose the society rented quarters in the Mott Memorial Library building, Madison Avenue near 27th Street. The success of the evening opening of its library warranted the step which was taken in 1890 of purchasing the property which had been altered by the New York Academy of Medicine for this purpose and which included not only a library space and equipment, but a convenient auditorium of small size for the holding of meetings. The society expects to be a participant in the provision of a wealthy engineer and donor whereby three of these national societies will be accommodated in a special building designed specifically for the needs of organizations of this class.

In addition to the publication of an annual volume the society conducts a free public reference library of engineering. This library is particularly rich in the current contributions to other scientific and engineering societies both in English and in other languages and in periodical literature published through the journals of technical journalism, both at home and abroad. This class of literature is of special significance in lines in which progress is as rapid as in the industrial departments of engineering. The library contains (1904) over 9,000 books and 3,000 pamphlets. It has also a valuable collection by bequest of antiquities in engineering and scientific matters, and obtains by exchange the scientific publications of the United States Government and corresponds with the important technical societies of Europe and the continent. The cosy auditorium and the library exhibit much material in portraits, busts, and memorials of engineering achievement. It is specially rich in drawings and other documents belonging to the work and history of Robert Fulton and early steam navigation.

The society has also discharged a valuable function by the service of professional committees on special subjects. These professional committees have mainly been concerned with the work of formulating the best procedure in various lines, with a view of having such procedure a species of standard whereby uniformity might be secured. Committees of the society have reported on uniform methods for conducting tests of boilers, on uniform methods of conducting tests of engines; on uniform standards in structural material, and have prosecuted research on the fire resisting properties of material, advisable methods for conducting tests of strength and similar problems.

These reports are made by the best experts connected with the society, and while the society officially never adopts their recommendation by legislative action, these recommendations carry great weight by reason of the sources from which they come.

The society is governed by a council, consisting of a president, six vice-presidents, nine managers, a secretary and a treasurer.

F. R. HUTTON,
Secretary of the Society.

American Society of Naval Engineers, organized 1888 for the purpose of publishing a quarterly journal covering the general field of

marine engineering and naval architecture with cognate subjects bearing on these. The publications of this society are regarded as works of reference by the marine-engine builders of the world, as well as by the admiralty officials of the various countries. During the existence of the society special effort has been made to cover every distinct feature of marine engineering design. While the council of the society has been exceedingly conservative as regards admitting original material to the columns of the 'Journal' of the society, special encouragement has been given to naval officers to take up original work, and to particularly note the engineering weaknesses of warship construction, so that each new type of war vessel, at least as far as machinery design is concerned, will be a distinct improvement upon its predecessor. Subscribers to the 'Journal' are members. Office of secretary, Washington, D. C.

American Street Railways. As far back as 1630 an enterprising mine owner at Newcastle-on-Tyne, finding the roads between his mines and the river so bad as to seriously interfere with the hauling of coal, conceived the idea of laying in the road wooden rails, and running thereon cars with wooden wheels. From that time to the present the transportation of goods and passengers has been a leading industry. The idea of the street railway grew out of the steam railroad agitation, when the first steam railroad was built in the United States in 1829. This idea rapidly materialized and the first street railway was built in New York City in 1832, the tracks being laid on Fourth Avenue from Prince Street to Harlem, the rail consisting of strips of flat-iron laid on granite blocks. The cars resembled the stage coach then in use and were mounted on flanged wheels. This road being a financial failure, it was not until 1836 that the next street railway was built in Boston. After this time street railways were built in all large American cities, and between 1860 and 1880 the horse railway had become an established institution. As cities grew and distances became longer, there was created a need of a motive power to draw the cars faster than horses could transport them. In some cases steam locomotives were used in the suburbs of large cities, but this was considered impracticable on account of the noise, dirt, and danger.

Numerous systems of propulsion were proposed and large expenditures were made in tests and trials. The first practicable method found was that of drawing the cars by an endless wire cable, and this method was first used in San Francisco in 1873 with much satisfaction where it was well suited for roads with heavy traffic and steep grades. This system was used in nearly all the large cities during the next 10 years. It was soon conceded, however, that the cable system was not the ideal one for moving cars as there were certain mechanical difficulties in its operation which were extremely burdensome, and experiments were continued with other systems between 1880 and 1890, resulting in the use of electric motors. The names of Edison and Thompson are identified with this work. The first street railway to be entirely equipped with electric cars and successfully and continuously operated, was a road 12 miles long, in Richmond, Va., built in 1888. As soon as this road demonstrated that the electric motor could pull street cars reliably and economically, horse roads all over the United States were changed to electric roads, and many new roads and extensions were built into the suburbs of the great cities.

The electric railway, a distinctly American institution, has now spread all over the world. In the United States there are more than 25,000 miles of electric railway track, covering an investment of more than $2,200,000,000, employing more than 150,000 persons and daily transporting about 15,000,000 people. Besides the transportation of passengers, express and freight cars, mail cars, parlor cars, and even funeral cars, are familiar sights on the street railways of American cities. Interurban electric railways have been built in the outskirts of the large cities, and between towns, on a large scale, and there are now very few towns of more than 5,000 inhabitants which are not connected with their neighbors by means of an electric railway.

Many problems in electricity have been developed in keeping pace with the street railway, the latest of which is the alternating current. It is readily seen that an alternating current system of electric traction which would permit the use of a high transmission line potential and avoid the transformation to direct current by means of the rotary converter, would give an impetus to the electrical solution of transportation problems greater even than that which followed the introduction of the rotary converter. That the direct current, because of its limitation as to voltage, is inadequate as a system for the distributing of power over a wide area, is now firmly established. The alternating current system, permitting a change of potential by means of the simple and efficient static transformer, has already successfully met the requirements of transmission and distribution of electric power. The necessity of using direct current for the operation of cars has, however, greatly restricted its application to general railway service, involving, as it does, the introduction of the rotary converter with its auxiliary apparatus, increasing the cost both of installation and operation and reducing the commercial efficiency of the system as a whole.

Catenary line construction is intended for high tension trolley roads, operated at potentials up to 6,000 volts or more. It is especially designed for use in conjunction with single phase alternating current railway equipment, and marks one step further in the movement to secure a greater degree of economy and efficiency in the operation of electric trolley lines. The employment of high tension currents for traction purposes necessitates the use of an improved trolley equipment, possessing an efficiency and a reliability of a high order. The speed attained upon interurban lines makes it difficult to obtain satisfactory service with a trolley wire which dips between supports and sags and sways with every impulse. Increased precautions against accidents and faulty construction are also necessary because of the increased liability of damage from any diversion of the line current from its proper channel.

In late years there has been a rapidly increasing demand for a controlling system applicable to trains of motor cars as well as to cars operated singly. This demand has been met by the development of the unit switch system of multiple control, which consists of a skillful

combination of electro-magnetic and pneumatic devices, each applied to those operations in which experience has shown it to be most effective. The construction is noticeable for the liberal design of its working parts and contacts, and the great margin of power available for their operation; while the general design and simplicity of operation insures great reliability of service and low cost of maintenance. See STREET RAILWAYS.

EDWARD S. FARROW,
Consulting Railroad and Mining Engineer.

American Sunday-school Union, a religious association having for its object the organization and support of Sunday-schools in needy neighborhoods, or those where religious sentiment is too divided to sustain denominational ones; the publication of religious juvenile literature, etc. It is not a union of churches, but of Christians of various denominations, requiring no common creed but a desire to save souls and promote the study of the Bible; and is managed entirely by laymen, though employing both ministers and laymen as officials and in its work, which of course includes the maintenance of missionaries to organize schools and enliven religious sentiment. It has had but six presidents in nearly 80 years of work,— Alexander Henry, John McLean, John A. Brown, Robert L. Kennedy, William Strong, and the present president, Morris K. Jesup. It has also a board of managers, the members elected for one, two, and three years; and an executive committee. Its headquarters are at Philadelphia, where it first came into being. Its germ was the First-Day Society, founded in 1791, whose managers petitioned for free schools in Pennsylvania; this led to the formation of the Philadelphia Sunday and Adult School Union in 1817, which later united with similar societies and changed its name to the present title in 1824. In 1821 the Philadelphia union published one book and supported one missionary; in 1902 it maintained nearly 100 permanent missionaries and published several thousand books and other publications. Its income is about $125,000 a year, and it organizes on an average about 1,350 Sunday-schools annually.

American Sycamore. See PLANE.

American System. See TARIFF.

American Tariffs. See TARIFFS, AMERICAN.

American Temperance University, a coeducational (non-sectarian) institution in Harriman, Tenn., organized in 1891. Professors, 30; students, 400; volumes in the library, 1,000; grounds and buildings valued at $100,000; graduates, 200.

American Textile Industry. See TEXTILE INDUSTRY, AMERICAN.

American University, The. Prof. Ladd of Yale University, in an essay originally read before the "Round Table" of Boston, about 1888, says: "Any one possessed of the requisite information knows at once what is meant by the university of France, the English universities, or a German university; but no one can become so conversant with facts as to tell what an American university is." And again: "— it is scarcely less true than it was a score of years ago, that, although there may be universities in America, no one can tell what an *American* university is."

While not so accurate at the present day as when first made, it is still true enough, if one fail to free himself at the very start from dependence upon the name as necessarily indicative of the thing. It is incontestable that within recent years the conception of the natural and necessary relation of the "university" to the "college" has become much clearer, and that many and important changes of organization and administration have resulted, so that it is certainly easier than it was in 1888 to define, or at least to describe, the American university. However, there remain difficulties of many kinds; and it still is, and will undoubtedly be for years to come, if not actually impossible, at least very difficult, to give a definition broad enough to include all institutions of learning in the United States which possess true university character, and precise enough to exclude all others.

The first difficulty is this: The names "university" and "college," as used in the official titles of institutions, are absolutely worthless as indications of the character of these institutions. Among the scores of titular "universities" in this country most are merely colleges, some good, some indifferent, some so badly endowed and organized as to be not even good high schools. On the other hand, Bryn Mawr "college" has never assumed, even in informal use, the name "university," yet offers true university instruction of the highest order in most of the subjects covered by the *philosophische Fakultät* of a German university; and even Harvard and Columbia, though they have now acquired a true university character, of a very elaborate type, and are habitually spoken of as such, have retained in their corporate titles their ancient designation of "college." It happens that in the most eastern States the word "university" is much less used as a title, the higher institutions of learning having mostly been founded while the English influence was still strong, many of them indeed in colonial times, under direct English authority, and so having adopted the peculiarly English name of "college." In the newer States more ambitious plans prevailed, and the consideration of conditions in non-English European countries — notably those of Germany, where the universities had obtained a more commanding position and influence than elsewhere by the beginning of the 19th century — led to the choice of the name of apparently greater dignity. This consideration seems also to have been paramount with the founders of the countless purely sectarian institutions which sprang up all over the country, and still lead a precarious existence, striving to hold the attention of their brethren in the faith by promiscuously showering down honorary degrees. Yet it would be grossly unfair to assume that in all cases the name of university was adopted out of pure conceit; in many the choice of name was the proclamation of a purpose sincerely cherished, and resolutely carried forward, amid difficulties of which the European critic can form no conception, to a realization more or less complete. It will be necessary then to get rid of this first difficulty by ignoring completely tne difference in title. If we shall succeed in describing the thing, though we may be ever conscious of the un-

fortunate ambiguity of terms, now doubtless too firmly fixed in official and legal use to be easily changed, we may rest content.

Another difficulty is this. It is now clearly seen that, as institutions, the college and the university, having very different functions, demand a different organization and administration. Yet the full recognition of this fact is comparatively recent, and the logical consequences have been reached in only a few instances. The circumstances of foundation and the necessities of the hour have made it practically impossible for the university and the college in the United States to exist apart. There are still but two institutions which may be called even fragmentary universities entirely unconnected with a college: The Clark University of Worcester, Mass., and the Catholic University of America at Washington. Down to 1876, when the Johns Hopkins University was opened, whatever real university instruction was offered was organized at a college already existing, and even the founders of the Johns Hopkins, though their chief purpose was avowedly to provide for university instruction of the highest grade, felt it necessary or at least advisable to organize a college also. The wide scope planned for Cornell University, opened in 1868, from the first necessarily included a college, nay, many colleges, as part of the scheme. In all discussion of the American university, therefore, in this article it must be borne in mind that the term (with the two exceptions noted above) is used to include only certain parts of institutions whose organism is often highly complex, and that probably no two institutions coincide in theory or even in practice, though certain principles and practices are common to those of more complete type.

What then is that American university, a description of which is here undertaken, if it does not anywhere exist in completeness and exactness, unobscured by contact with institutions of different character and divergent aims? It will be least misleading to say at the outset: It is nowhere. In so far, therefore, Prof. von Holst's famous pronouncement is right: a university in the European sense does not exist in America. And yet, from Harvard on the Atlantic tidewater to the University of California, which looks out through the Golden Gate upon the Pacific, and from Minneapolis to New Orleans, will be found many institutions which offer training in the methods of scientific research, opportunities for the prosecution of such research, and abundant facilities in the way of libraries, museums and laboratories, to those individuals who have had such preliminary training as to be able to profit fully by these advantages, and which certify by the formal bestowal of a particular degree or degrees that the individual receiving one of them has proved himself or herself to have acquired the methods and habits of such scientific research. This is equivalent to saying, in the technical language in vogue in the United States, that these institutions offer to graduate students courses leading to advanced or higher degrees. Where such courses are well organized and equipped and successfully maintained, there is a university at least in part, and, it may be, in the whole. Whether the institution do only this, or this and many other things besides, and whether it be called university or college, may be important questions from some points of view; for the point of view of this discussion the existence of such organization for research work by graduates is the test, and it is its purpose to describe as clearly as possible such organization of this character as may be found in the United States of America. Apparent or evident divagations from this strict purpose will perhaps find readier pardon from the foregoing allusions to some of the difficulties in the way.

It has often been remarked by observant foreign travelers in the United States that among this young people many institutions change less rapidly than in the older nations of Europe. This conservatism, in large part an English trait persisting through many generations, is particularly observable in the field of education; experiments are carefully tried, downright innovations still less willingly adopted. Only where occasion is offered for new foundations are we apt to find a ready breaking with traditional forms. When, on reviewing the American institutions of learning to discover which of them give the opportunities for training in the methods of research that we have taken as our standard of measurement, we find them to be almost without exception colleges, or technical schools, or professional schools as well, or all of these together, we also find that they were generally colleges first of all, and that training in research was made a part of the system only later, very gradually and hesitatingly, the two institutions which disclaim all "college" work being almost the youngest, and one of them not yet displaying a very encouraging vitality. We find also that one of the oldest and most famous colleges of all, Yale, was also the first to institute regular courses of instruction for those who wished to pursue their studies after receiving the degree of bachelor of arts.

The union of college and university may fairly be called the typical American form of organization for the higher education. Only in the institutions of comparatively recent origin do we find that university organization was attempted from the first. The professional and technical schools have generally occupied a position of great independence toward the institution as a whole, in many cases having hardly more than the name in common, but possessing their own budgets and boards of trustees, sometimes even being administered as proprietary schools, wherein the professors divided among themselves the fees paid by the students. The medical schools have been the most independent in this respect. It should be borne in mind that in the case of such complex institutions the name "university" is applied to the whole, so that, theoretically at least, the university may include the equivalent of a German university, *technische Hochschule* (formerly called *Polytechnicum*), *landwirtschaftliche Hochschule* or agricultural college, and *Gymnasium*. Passing under review the many types of organization wherein university and college are united, we find that in most cases the graduate and undergraduate work are carried on by the same individuals, so that, instead of a university and a college being in alliance, so to speak, as might be said if the body of instructors of each

part were composed of quite different individuals, with one governing body for the whole, we have to do really with a complex and overlapping structure. Herein lies, it must be said, one of the greatest disadvantages for the American university, though there are valuable compensations. The American university professor is rarely able to devote himself exclusively to advanced scientific work with well-prepared students, but must, in most cases, carry on a good deal of mere class work as well, which cannot but prove detrimental to the progress of his researches.

The State Universities.— At the present time, in each of 29 of the States of the Union, there is maintained a single "State university," supported exclusively or prevailingly from public funds, and managed under the more or less direct control of the legislature and administrative officers of the State. In some cases private benefactions have notably supplemented the support given from public revenues. These States are the following: Alabama, California, Colorado, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, North Carolina, North Dakota, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Texas, Virginia, Washington, West Virginia, Wisconsin, Wyoming.* The organization of these institutions, while more similar than that of the universities which are autonomous corporations, yet shows many points of divergence; and their extent and standards of scholarship vary even more widely. The larger among them exhibit a very complete development of technical and professional schools, with the exception of schools of theology, which naturally have no place in a country where State aid is not extended to religion. The professional schools of law and medicine, however, are generally supported, at least in greater part, by the fees received from students, and up to the present time none of them has been put on a true university basis. Otherwise, the sources of income of these universities are mainly the following: (1) The proceeds of land-grants made in 1862 by the Federal government, in accordance with the famous "Morrill Act" of 1862, for the maintenances of colleges whose leading object should be instruction in those branches of learning relating to agricultural and mechanical arts, including military tactics, and not excluding other scientific and classical studies. (2) State taxation, whether by way of annual appropriations from the general taxes of the state, or by continuous appropriations from a permanent special tax. (3) Tuition fees (only in some of the universities, while in many instruction is entirely gratuitous). (4) Private gifts and endowments — the least common source of revenue, although some brilliant exceptions are to be noted.

The universal verdict of public opinion, in the States where such institutions are maintained, is that they, as State organizations supported directly by public taxation from which no taxable individual is exempt, should be open without distinction of sex, color or religion to all who can profit by the instruction therein given. Each forms the uppermost division of the general system of public education of the State in which it is maintained, and is managed with a view to completing the scheme of instruction begun in the primary and carried on in the secondary schools. Control is vested in a board of public officials, generally called "regents." For example, the board of regents of the University of Minnesota consists of the governor of the State, the superintendent of public instruction, the president of the university, and seven members appointed by the governor and confirmed by the senate. In Michigan the regents are elected by popular vote for terms of eight years — an unusual feature. The composition and mode of choice of these boards varies greatly in different States, and not less their fitness for the responsibilities entrusted to them. In some States, as in Michigan and Wisconsin, the result of many years' endeavor has been, though after many vicissitudes and bitter struggles, the creation of noble schools of training; in others the constant changes in political complexion of the legislature, and the self-seeking of party leaders, have made the universities mere shuttlecocks of public or party opinion, and not only has their development been hindered, but in some cases their usefulness deliberately crippled. Instances are not unknown where particularly able and courageous professors, who would not cut their scientific opinions after the prevailing fashion in politics, have been driven from their chairs, even by outrageously underhanded methods. Of the State universities the most prominent and successful are those of Michigan, Minnesota, Wisconsin, and California. The first mentioned is the oldest and perhaps the best known. Under the direction of a series of singularly able men it has grown, since its foundation in 1837, into a position of commanding importance. The three others, while considerably younger, have shown a surprisingly rapid growth. See STATE UNIVERSITIES.

Contrast with European Universities.—The foregoing account of the chief types of university organization in the United States will, it is hoped, have made clear most of the details in which their structure is peculiarly American. The older institutions, starting from the English type of college, never developed in the direction of universities of Oxford and Cambridge, where the idea of the university as a great teaching body was lost in the excessive development of the college as a place of residence, and of the university as primarily a congeries of colleges. The early mediæval universities of Europe, on the continent as well as in England, generally provided for their students places of residence in buildings set apart for this purpose, instruction of the lower grades in connection with these residence halls, and higher instruction independently of them. On the continent, however, especially in France and Germany, the residential feature rapidly became less important, and finally, with a few unimportant exceptions, disappeared altogether, so that the entire resources of the universities, though often scanty enough, could be turned to account for the work of instruction. In England exactly the opposite occurred; the residential halls became, through the impulse of successive pious foundations, the important factors in the university life, even attaining corporate independ-

* The University of the State of New York is not a university at all, but rather a State board of education, with supervision of all instruction given in the State. The "University of France," as constituted under Napoleon I., is closely analogous to it.

ence and ultimately great wealth, and gradually assumed most of the instruction of the students, though the examinations and the award of degrees remained the prerogatives of the university as a whole — conditions which made directly for the fixity of residence characteristic of English universities, and adopted as a matter of course in the American colleges patterned after the English model. If the establishment of Harvard and Yale colleges had been followed at brief intervals of time by the foundation of other residential colleges in Cambridge and New Haven, and if there had existed in the colonies an established church with a prestige such as that possessed by the Church of England in the home country, keeping the colleges under its control, a state of affairs similar to that at Oxford would doubtless have resulted. The scanty population and limited means of the colonies, and their independence of the Church of England, prevented such a result, fortunately, on the whole, for the educational welfare of the country at large. Yet the residential feature has persisted throughout the history of the American college; though abandoned here and there, as at Columbia and the University of Pennsylvania, it has been restored at the latter, has again been adopted in principle, if not yet in practice, at Columbia, and deliberately introduced, in various forms, at many new institutions, even in some which at first had made no provision for students' residence. The American institutions differ furthermore from the English universities in this, that their growth has been so largely in the direction of professional and technical schools, though these have been thus far in less than a half a dozen instances placed on a real university basis.

The points of difference between the American and the continental European universities are not less apparent. Taken as a whole, the American institutions exhibit only a portion of what in Europe is thought necessary to the constitution of a complete university, viz., the traditional four faculties of theology, law, medicine and philosophy, because, although all four may be in existence (as for example at Harvard), they are not all organized and administered on the same plane; but on the other hand they include elements which in Europe are sharply marked off from the universities, namely, technical schools, and undergraduate schools, which in some cases correspond fairly well to the lycée or gymnasium of France or Germany, in others to the last two or three years of these institutions and the first year of the university or technical school. If we separate the strictly graduate schools of the American universities from the remainder of their respective institutions, we shall find them in general covering pretty nearly the ground of the "philosophical faculties" of Germany, and more or less closely approximating them in methods of work. A decided point of difference, however, consists in the comparative infrequence of migration on the part of students from university to university, which is so nearly the universal rule in Germany.

Present Day Problems.— When the problems of education are all solved, education itself will be dead, and the need of it greater than ever. The entire range of education in the United States has been in a state of rapid transition for many years already, and nowhere have the changes been more constant than in the domain of college and university education. From the establishment of graduate courses at Yale in 1847 until the present day, probably no year has passed without seeing some new experiment tried, some old institution reorganized or new one founded. If the new institutions have often shown too little willingness to profit by the experience of others, or to adopt the ways and means of other lands, it must be remembered that the educational problem has been but one of many with which the leaders of thought in this country have been confronted, and that in the attempt to conform institutions to the spirit of the country it has been necessary first to discover, often at great pains and heavy cost to the experimenter, what that spirit was.

Naturally the most important question has been and still is that of organization. It has doubtless become apparent from the foregoing description that no two universities are just alike, and that the differences do not by any means concern unimportant points. Every possible variety of organization and administration seems to the observer — especially the foreign observer — to have been tried, except that of a consistent and rigid adherence to forms sanctioned by centuries of permanence in Europe.

The vacillation has come from uncertainty as to the true purposes of the university. In Europe these purposes were long ago settled: the university exists to train servants of the state, or, as prevailing in England, to train up a race of gentlemen who shall never forget the obligations of their caste. It is the glory of Germany that she has seen more clearly than other nations how truly the highest scientific training is none too good for her public servants.

The wholly different conditions prevailing in the United States have been reflected in the organization of our universities and colleges. There is no state religion, and the national Constitution forbids the patronage or proscription of any sect; consequently the theological faculty, originally the most important in the universities of western and northern Europe, found no state recognition. The practice of the law was subject to few restrictions, and indeed in at least one State is still open to every citizen of mature age, so that the schools of law, when they began at all, grew up mostly on a basis of private organization, with purely practical training as their object, and often underbid one another in their eagerness for students. With such exceptions as the nature of the profession brings with it, the regulation of the study and practice of medicine went the same course, proprietary schools being the most frequent form of organization for instruction in the healing art. As for the faculty of arts or philosophy, which, originally preparatory for one of the others, had in Germany been put on a par with them and made the doorway to the new profession of teaching in the State schools, its ground was partially covered by the curricula of the best colleges. The character of these colleges, however, resembled more nearly that of the German philosophical faculty of two centuries ago. The state systems of education did not at first include more than elementary schools, so that there was no great incentive for prescribing a college course for those persons who wished to teach in them; nor would such a regulation have been popular in intensely

democratic communities, or, in the poverty of many of the states, easily possible of fulfilment. Under these circumstances the European conception of a university was lost; and when it began to be regained, different systems, imperfect and incongruous it is true, but still in many ways useful, had grown up to fill the needs which are supplied in Europe by the university. Other needs had made themselves felt in America even more keenly: the needs incident to the rapid settling and exploitation of a new country, where vast distances and a phenomenal growth of population made imperative some provision for training in the technical professions and mechanical arts. It is not strange, then, though it has been unfortunate for the country at large, that the last need to be recognized in education has been the need of thorough training in the humanities and in pure science, in what has been admirably well called "disinterested scientific thinking, as distinguished from technical or commercial science."

American educators are not yet at one as regards the true function of the university. In general, two opposing views are chiefly held. The purpose of the Leland Stanford, Jr., University is declared to be: "To fit young persons for success in life." An admirable purpose, no doubt, but one which the university must share in common with many other institutions. Of a like breadth of conception is the avowed purpose of Ezra Cornell: "I would found an institution where any person may find instruction in any study." The brilliant history of Cornell University is chiefly due to the wisdom of the men who have seen what limitations should be put upon this great plan. This view of the true function of a university is chiefly prevalent in the West; one sometimes hears it said that the western universities exist solely for the sake of the students, while some of the eastern universities seem to think that the students exist chiefly for the sake of the universities or of science at large. The universities of private foundation are proceeding more and more on the assumption that their function is to train, in their graduate departments or faculties of philosophy, specialists, as teachers, and to a less extent as investigators; those which have raised some of their professional schools to true university rank by refusing admission to all who have not received a non-professional degree aim not merely to instruct the future physicians and lawyers in the technique of their professions, but to give them true scientific insight and philosophic grasp. Until there is agreement as to the true function of a university, there cannot be agreement as to their organization and administration. Whoever holds to the Stanford idea will wish to see all departments of instruction put on precisely the same plane; whoever believes that scientific research is the highest and noblest aim of education will demand for the university an organization which shall emphasize this, leaving to other institutions the teaching which is entirely practical.

As a whole, American universities seem to be trying to do too many things at once, generally with an altogether inadequate equipment of instructors, and with an insufficient endowment Each university aims to cover the entire field of instruction; the result is that the professors, who are, except in the professional faculties, almost always college instructors as well, are cruelly overburdened with teaching and administrative duties, with the inevitable result that few of them can carry on much research. The organization of most of our universities is too complicated. Many professors have to attend two, three, or even four faculty meetings each month, and serve on committees without number; some of them are even expected to do purely clerical work.

Perhaps the most important of American university problems at present, as bearing directly upon the necessary organization and determining it, is the relation of university or graduate work to undergraduate work and to professional training. With the very liberal regulation, often lack of regulation, exercised by the State governments over the practice of the professions of law and medicine, the number of practitioners has inevitably become excessively great. The need of stricter control has been seen, and many States have increased the requirements for admission to practice. That any of the States will require a complete collegiate education as a preliminary to admission to practice is a very remote possibility. It rests with the universities to raise the plane of their professional schools so that only the fittest will survive. Experience has shown that raising the standard of an institution is surely followed in a few years by an increase in numbers as well as in the quality of students entering. A beginning has already been made, as indicated above, for the professional schools of law and medicine. As for the technical schools, most of them, whether connected with the universities or not, have been too ready to admit students on very slight requirements. Perhaps in time the best of these will see that a good preliminary training ought to be demanded of their students, and so put themselves also on a university level.

Enough has been said, it is hoped, to show that there is little chance of re-establishing in any American university the traditional four faculties, unaccompanied by any other departments of instruction. If means were abundant, it would perhaps be advisable to separate entirely from the universities the technical schools, except such as should be willing to demand a preliminary degree for admission and to develop more fully the theoretical and research side of their teaching. At present undue prominence is given to the technical schools in many institutions, largely because they are the best paying parts, and the tone of the whole institution, as an organization that should exist as largely for the advancement of research as for any other cause, is distinctly lowered thereby.

The graduate school, or faculty of philosophy, bears closer relations with the collegiate course than can be borne by any professional faculty. The overburdening of professors alluded to above might be remedied by the appointment, where endowments would allow, of professors exclusively for graduate work on the lines of the faculty of philosophy, who should be able to engage in extended research work with advanced students. Hitherto no institution has been in a position to do this in any large degree. Nor has it been possible to try on a really instructive scale the experiment of a university without college or technical schools. Whether such a university could properly maintain a faculty of theology, it is hard to say.

The Union Theological Seminary in New York, while under Presbyterian management, is in many respects a real university faculty, and the same may be said of some few others. The relations between Columbia and the Union Seminary have become close, with the good result that many students of the latter attend courses at Columbia under the faculties of political science and philosophy, and are eligible for Columbia degrees.

Concerning the precise relation to be borne by the graduate work to that of the college, no general agreement has yet been reached. Even where the two are carefully separated, no such great dissimilarity in methods exists as prevails in Germany between the gymnasium and the university. Where, as at Harvard, the lines of demarcation are partly obliterated, the change from one method to another is very gradual. Johns Hopkins aims above all at producing specialists, and even her college courses are largely shaped to this end. The results certainly justify her policy.

The preparation which the candidates for admission to the graduate schools bring with them is naturally very varied. For many kinds of advanced work, the general training given in the college is not enough; so that the student, in order not to lose much valuable time afterward, has to begin his special studies before receiving his first degree. This is encouraged by the system in vogue at Columbia, especially in the case of students looking forward to medicine or the law. A tendency to over-early specialization is showing itself in many places; the students are naturally anxious to begin the active duties of life as soon as possible, and are unwilling to postpone the acquirement of the professional degree until the 25th or 26th year of their age. A remedy for this has been sought in several directions, but none of the plans tried has been successful enough to prevail over the others. The trouble seems to lie largely in the loss of time during the earlier school years. The pupils are not taken in hand early enough, nor do they receive severe enough training. With the improvement in organization and methods which is everywhere noticeable, it ought to be possible after a few years to send young men and women to college at 16 as well prepared as they are now at 17 or 18. With this done, the college course might well be shortened to three years.

It may be asked, what of the *Lehrfreiheit* and *Lernfreiheit*, the freedom for teacher and learner, as they are claimed for the universities of Germany, in those of America? As for the first, the American university professor has little cause for complaint; whatever may have been the case 25 years ago, he may now teach what he likes nearly everywhere, though now and then the regents of a State university, or the religious body controlling a divinity school, raise noisy protest. In one respect there is yet much room for improvement: as yet no serious effort has been made to introduce one of the most valuable features of the German university system, the system of *Privatdozenten*. It is not yet possible for a young man of ability to secure the right of lecturing at a university by merely proving that he is competent to do it. The introduction of this custom has been several times attempted, but so far with quite insignificant results.

As for the *Lernfreiheit*, that too has become naturalized among us; even the undergraduate enjoys a large measure of it, largest in those colleges where the elective system has taken firm root. One development of it, the migration of students from one university to another without loss of standing, is still unsatisfactory. The custom is highly desirable, and is steadily gaining ground in America; it is much commoner from the colleges to the purely professional schools, students of law and medicine naturally seeking the large cities; the chief obstacles to its adoption are the differences between the various universities in the matter of organization and of requirements for degrees, and the close connection between college and university which lead the college graduate in many instances to remain for graduate work where he has taken his bachelor's degree, out of pure attachment to his alma mater.

It is interesting to observe how rapidly the spirit of independence with responsibility is developing among the graduate students. At 22 or more institutions which maintain graduate schools the students in these have formed themselves into associations for the furtherance of their mutual interests, and these clubs have formed a national federation which holds annual meetings, where papers are read, and questions affecting the whole range of graduate work are discussed. The interest shown in these proceedings, and the intelligent spirit in which many important questions are approached, make these associations into a most valuable adjunct to the work of the graduate schools. At the fourth annual convention, held at Cambridge, Mass., in December, 1898, addresses were delivered by President Eliot and Prof. J. W. White, of Harvard, and papers were read, followed by animated discussion, on the following topics: The migration of students; the regulations concerning major and minor subjects; specialized scholarship *v.* preparation for teaching, as a basis for graduate study; the master's degree; graduate studies in European universities; the regulation of graduate to undergraduate courses. The federation of graduate clubs also carries on a determined opposition to the practice of conferring the Ph. D. *honoris causa*.

A project vigorously advocated by many eminent American educators is the foundation of a national university for the United States, to be situated at Washington, to be controlled by a board of regents under the chairmanship of the President of the United States, and to be constituted on the true university basis of admitting to any of its schools only those who have received the preliminary training shown by the possession of a bachelor's degree. The plan is an alluring one from some points of view. (See NATIONAL UNIVERSITY.) To add another institution of learning to those that swarm in the United States, unless the new comer should at once outrank them all in the magnitude and completeness of its equipment, and unless its rise should imply the setting of a number of the minor lights, would be a very doubtful service to the cause of university education. So far no endowments at all comparable with those of half-a-dozen of the universities already existing have appeared; and it is extremely doubtful whether congress could be depended upon to give the institution the thoroughly adequate sup-

port without which it must remain at best one additional "torso of a university."

EDWARD DELAVAN PERRY,
Columbia University, New York.

American University, The, a post-graduate institution in Washington, D. C., founded under the auspices of the Methodist Episcopal Church in 1891, with Bishop John F. Hurst as chancellor.

American Water-color Society. See WATER-COLOR SOCIETY, AMERICAN.

American Whigs. See WHIGS.

America's Cup. See YACHTS AND YACHTING.

Americus, Ga., county-seat of Sumner co., on the Georgia & A. and Central of Ga. R.R.'s, about 75 miles southwest of Macon. The town was settled in 1832, and is governed under a charter granted in 1889. There is a mayor and council of six. It is the business centre for a large cane and cotton region and has also several manufacturing industries. Pop. (1900) 7,674.

Amerighi Michelangelo. See CARAVAGGIO.

Amerigo Vespucci. See VESPUCCI.

Amerind, a word suggested by Maj. J. W. Powell to describe the American Indians as distinguished from other Indians.

Amerling, ä'mėr-lĭng, **Friedrich,** Austrian painter: b. Vienna 1803; d. there 1887. He studied painting in Vienna, and also in London, Paris, and Munich, and spent some years in Italy. Upon his return to Austria he was selected to paint a portrait of the Emperor Franz I., and from that time ranked as the most prominent portrait painter of that country. His portraits number about 1,000, and are distinguished by brilliant coloring, but sometimes fail of definiteness of characterization. Consult: Bodenstein, 'Hundert Jahre Kunstgeschichte Wiens' (1888); and Frankl, 'Life' (1889).

Amersfoot, a town in Holland, in the province of Utrecht, and 12 miles northeast of the town of Utrecht. By the Eem, on which it stands, it has a navigable communication with the Zuyder Zee. It manufactures woolen goods, tobacco, glass, and silk-yarn, and carries on an extensive trade in grain. The Roman Catholic church of St. Mary, built in the 14th century, has a Gothic tower 308 feet high, considered to be one of the finest in Europe. There is a college of the Jansenists in the city, it being one of the chief centres of this sect, which does not now exist outside of Holland. The Grand Pensionary of Holland, Jan von Oldenbarneveldt, commonly called Barneveldt, was born here. Pop. (1902) 20,500.

Ames, Adelbert, American soldier and Reconstruction official: b. Rockland, Me., 31 Oct. 1835. Graduating at West Point in 1861 he was assigned to the artillery and served through the Civil War with distinction: was wounded at Bull Run and brevetted for gallantry there; took part in nearly all the battles of the Peninsular campaign, in Fredericksburg, Chancellorsville, Antietam, Gettysburg, and before Petersburg; was brevetted colonel, was brigade and division commander at times, brevetted major-general of volunteers for conduct at the capture of Fort Fisher, and major-general in the regular army for general conduct in the war. In 1866 he was made lieutenant-colonel. From 1868, when he was appointed provisional governor of Mississippi (extended the next year to the 4th military district of the States lately in insurrection), to 1876, he was in the thick of the "carpet-bag" troubles; upheld by United States troops, the negro vote, and a small section of whites, mostly recent immigrants, and bitterly fought by the mass of the white inhabitants. Mississippi was among the last of the revolted States to accept Reconstruction or the War Amendments as fixed facts. The preponderant negro population and the backwardness of much of the white made the race problem more acute there than anywhere else in the South; the elements at Ames' disposal were unfit to base even a decent civilized structure upon, and they frightfully plundered and misgoverned the State; on the other hand, according to his side, the white portion would not do its best to reduce the evils by co-operating in good faith with the administration, and simply defied all orders: and the State went into anarchy tempered by local vigilance committees. He held an election for a legislature 30 Nov. 1869, convened it 11 Jan. 1870, was elected United States Senator for the unexpired term from 4 March 1869, and in 1873 was elected governor of Mississippi and resigned his seat in the Senate — the whites regarding all these elections, under the conditions, mere military usurpation and illegality. His governorship was charged with sacrificing the civilized interests of the State to the blacks, and on 7 December there was a bloody race riot at Vicksburg, followed by others through the State. Ames sent to Washington for more troops to maintain order, the white party countered with fresh charges, a congressional investigating committee was appointed, and for two years the State had — like several Southern States through this period — a formal government perfectly powerless, and a real government consisting of the rough consensus of interest among the larger white landowners. In November 1875 these recovered control of the State by suppressing the negro vote wherever troops were not actually present. The legislature which met in January impeached Ames and all his executive officers; the State Administration was paralyzed; the national administration was sick of upholding impossible local governments; and Ames finally agreed to resign if the impeachment were withdrawn. He at once removed to New York; later to Lowell, Mass. In the Spanish-American war he was a brigadier-general of volunteers.

Ames, Charles Gordon, an American clergyman, editor, and lecturer: b. Dorchester, Mass., 3 Oct. 1828. He graduated at the Geauga Seminary, Ohio; was ordained in 1849 as a Free Baptist, but later became a Unitarian and pastor of the Church of the Disciples, Boston. He was editor of the Minnesota *Republican*, the first Republican paper in the Northwest, in 1854, and the *Christian Register* of Boston, 1877–80. He wrote 'George Eliot's Two Marriages' (1886); 'As Natural as Life' (1894); 'Poems' (1898); etc. He has preached and lectured in 20 States, and has always been deeply interested in social and philanthropic questions.

Ames, Eleanor Maria (EASTERBROOK), pseudonym "Eleanor Kirk," author: b. Warren, R. I., 7 Oct. 1831. Besides numerous contributions to newspaper and periodical literature, she has published: 'Up Broadway, a Life Story' (1870); 'H. W. Beecher as a Humorist: Selections' (1887); 'Information for Authors' (1888); 'Periodicals that Pay Contributors' (privately printed); editor 'Eleanor Kirk's Idea,' a monthly magazine.

Ames, Fisher, American orator and statesman: b. Dedham, Mass., 9 April 1758; d. there, 4 July 1808. His father died when he was six. A precocious scholar, he graduated from Harvard at 16; taught school some years to support his impoverished family, cultivating himself by wide reading and profound study of the classics and the Scriptures; studied law, and began practice in Dedham in 1781. He made a reputation as "Brutus" and "Camillus" in the Boston papers, was sent to the legislature in 1788, won laurels, and was elected to the convention to ratify the Federal Constitution. His speech there on biennial elections gave him fresh repute as one of our foremost orators. In December he was elected (Federalist) Representative to Congress, and re-elected through Washington's administration to 1797: he was chosen to pronounce the congressional address to Washington on his retirement; and on 28 April 1796 delivered his masterpiece of eloquence and effectiveness, on the appropriation to carry Jay's treaty of 1794 into effect,— so impressive that the other party protested against taking a vote until after an adjournment, because the House was too excited to decide rationally. Retiring from public life on account of feeble health, he spent his later years mainly on his Dedham farm, though writing papers in 1798 to urge the Federalists to resist French aggressions, which was pouring oil on a conflagration (see ADAMS, JOHN; ALIEN AND SEDITION LAWS, and the names of the various political parties of the time), serving for a time on the State Council, and delivering a eulogy on Washington before the legislature. He declined the presidency of Harvard in 1804. He was an orator by inspiration, studying his subject and taking notes to expand on the moment, and full of flashing epigrams and pregnant laconics. A large public school in Dedham Centre commemorates his name. ('Works and Life,' 1 vol. 1809; 2 vols. 1854, by his son Seth; selected speeches, four new, 1 vol. 1871, by his grandson.)

Ames, James Barr, professor of law: b. Boston, 22 June 1846. Graduated at Harvard in 1868, the Law School, 1872. Instructor in history, Harvard, 1872–3; associate professor of law, 1873–7; professor of law since 1877, and dean of the law school since 1895. He is the author of numerous articles in the 'Harvard Law Review' and other legal periodicals, and has compiled collections of cases on torts, pleading, partnership, notes and bills, and suretyship.

Ames, Joseph, painter: b. Roxbury, N. H., 1816; d. New York, 30 Oct. 1872. Though wholly self-taught he early began portrait-painting, opened a studio in Boston, and had success enough to obtain means to go to Rome and study. While there he painted a fine portrait of Pius IX. He was elected member of the National Academy of Design, 1870, and soon had more orders than he could fill. Some of his best known portraits are those of Ristori, Prescott, Emerson, Rachel, and President Felton of Harvard. 'Maud Muller' and 'The Death of Webster' are his best known ideal paintings.

Ames, Joseph Sweetman, professor of physics: b. Manchester, Vt. 3 July 1864. He graduated at Johns Hopkins in 1886 and is professor of physics there. He is author of 'Theory of Physics' (1897); 'Manual of Experiments in Physics' (1898); 'Free Expansion of Gases' (1898); 'Induction of Electric Currents' (2 vols. 1900); editor 'Scientific Memoir Series,' 'Fraunhofer's Papers'; assistant editor 'Astrophysical Journal,' 'American Journal of Science.'

Ames, Mary Clemmer, American journalist and author: b. Utica, N. Y., 1839; d. 18 Aug. 1884. Educated in Westfield, Mass., she began very young to write for the Springfield *Republican;* then removed to Washington and became for many years a regular weekly correspondent of the New York *Independent,* her 'Woman's Letter from Washington' in which made her one of the best known and most influential woman writers in the country. Her style, especially on attractive masculine personalities, was somewhat Oriental; but she was honest and sincere in a time of pervasive lobbyism and self-seeking. She wrote also biographical sketches of the Cary sisters, Emerson, Longfellow, Charles Sumner, Margaret Fuller, and George Eliot; 'Ten Years in Washington' (1871); 'Outlines of Men, Women, and Things' (1873); the novels 'Victoria' (1864), 'Eirene' (1870), and 'His Two Wives' (1874); and a volume of poems (1882). She married early Rev. Daniel Ames, and was divorced; in 1883 Edmund Hudson, proprietor of the 'Army and Navy Register.' Her home in Washington was long a social and literary centre. (Works, Boston, 1885; memorial by her husband, 1886.)

Ames, Nathan P., American manufacturer: b. 1803; d. 23 April 1847. In 1829 he established cutlery works at Chicopee Falls, Mass., which attained a national reputation, their swords especially being largely bought by the United States. In 1834 he removed the works to Cabotville (Chicopee), where he lived and died; and incorporated with others the Ames Mfg. Co., which in 1836 added a bell and bronze cannon foundry that had equal fame and furnished the larger part of the government's brass cannon in the Civil War, as well as the bronze statues of De Witt Clinton in Greenwood Cemetery, Brooklyn, N. Y., of George Washington in Union Square, New York, and of Benjamin Franklin in School Street, Boston. The works supplied the British government just before the Crimean war with machines for making muskets.

Ames, Oakes, manufacturer and promoter: b. Easton, Mass., 10 Jan. 1804; d. 8 May 1873. The son of a blacksmith who had become a manufacturer of highly reputed picks and shovels, he trained himself in his father's works, and with his brother joined the firm as Oliver Ames & Sons. The opening up of California in 1848 and Australia in 1851 by the gold dis-

coveries created an immense demand for their goods in mining, settlement, and railroad building, which raised the firm to the front rank in business and wealth; and in the Civil War they had great contracts for shovels, swords, etc. Mr. Ames was in the Massachusetts executive council 1861, and congressman 1862 till death. In 1864 the failure of attempts to carry through the nationally exigent Pacific Railroad led President Lincoln's government to call on Mr. Ames to undertake it. He risked financial ruin if it failed, investing $1,000,000 and making his whole fortune responsible for the rest: it could not be expected that he should forego a corresponding profit if it succeeded. The work was finally accomplished by organizing a construction company (see CREDIT MOBILIER OF AMERICA), which paid itself largely in stock and bonds of the Union Pacific, practically making the two companies one, and enabling the former to charge the latter its own prices for work and supplies, the government paying the bills. Credit Mobilier stock became enormously valuable, and the directors were charged with cheating the government and using the stock to buy congressional support for the fraud. Mr. Ames' anomalous position as congressman, director in both companies, contractor for immense supplies to the railroad, and the ablest manager of the whole enterprise, caused the chief fury of the assault to fall on him; and in the tremendous public scandal and investigation which followed he was censured by the Forty-second Congress and died shortly after. His son Oliver (q.v.), however, induced the Massachusetts legislature to re-examine the case, and on 10 May 1883 (the 14th anniversary of the completion of the railroad) it passed a resolution exonerating Mr. Ames. The Union Pacific Railroad erected a monument to his memory at Sherman, Wyoming, the crest of the road, 8,550 feet above the sea.

Ames, Oliver, manufacturer, brother of Oakes above: b. Plymouth, Mass., 5 Nov. 1807; d. 9 March 1877. His brother's partner, he was a sharer in all his business enterprises; president *pro tem.* of the Union Pacific Railroad 1866–8, formal president 1868–71; a director in the Credit Mobilier. After his brother's death he became head of the manufacturing firm. He was a member of the State Senate 1852 and 1857.

Ames, Oliver, manufacturer, son of Oakes above: b. North Easton, Mass., 1831; d. 1895. He was trained in his father's works, and as his heir spent several years in paying off the obligations of millions of dollars incurred by the Union Pacific Railroad and other undertakings. Entering public life avowedly to vindicate his father's memory, he was lieutenant-governor of Massachusetts 1882–6; in 1883 obtained the vindicatory resolution he sought; and 1886–8 was governor.

Ames, Samuel, jurist: b. Providence, R. I., 6 Sept. 1806; d. there 20 Dec. 1865. Graduated at Brown, 1823; studied law with Judge Gould at Litchfield, Conn. He served for many years in the Rhode Island State Assembly, being speaker 1844–5. He was elected chief justice of the State supreme court 1856, but resigned in 1865 on account of ill-health. In 1839 he married Mary Throop Dorr, daughter of Thomas W. Dorr, leader of the rebellion in 1842. Author and editor of 'Angell and Ames on Corporations,' and vols. 4–7 of the 'Rhode Island Reports.'

Ames, Iowa, city in Story County, on the Chicago & N.W. R.R. It is the seat of the State Mechanical and Agricultural College and has a public library, banks, churches, schools, and two newspapers. It was first settled in 1864. Pop. (1900) 2,422.

Amesbury, Mass., town in Essex County, situated on the Merrimac River and on the Boston & Maine R.R.; 27 miles north of Salem. It has manufactories of cotton and woolen goods, boots and shoes, machinery, and carriages, and was long the residence of the poet Whittier. The town was settled in 1630. Pop. (1900) 9,473.

Ametabola, those insects in which development is direct, there being no metamorphosis.

Am'ethyst (from the Greek *amethystos,* "not intoxicated"). In mineralogy (1) a violet or purple variety of crystallized quartz, the color being probably due to traces of manganese or iron. It is esteemed as a gem, and was worn by the Greeks in the belief that it lessened the intoxicating effects of alcoholic drinks upon its possessor. It is widely distributed, but specimens pure enough in color to be used as gems are not common. The finest amethysts come from Brazil, India, Siberia, Pennsylvania, and North Carolina.

(2) The precious (or Oriental) amethyst is a crystalline oxide of aluminum, violet in color from the presence of traces of some other metallic oxide, and very brilliant and beautiful. Mineralogically the Oriental amethyst is a variety of corundum (q.v.).

Amhara, äm-hä'rä, a district of Abyssinia, lying between the Tacazzé and the Blue Nile, but of which the limits are not well defined. The Amharic language, next to the Arabic the most widely used of all the Semitic languages, has gradually gained ground in southern and central Abyssinia, and has become the court language. It has a literature of its own, including a version of the Scriptures.

Amherst, Jeffery, Baron, British soldier remembered for his American services: b. Kent, England, 29 Jan. 1717; d. 3 Aug. 1797. He was a duke's page, by his favor entering the army as ensign at 14, and became Gen. Lord Ligonier's aide; served through the war of the Austrian Succession, 1741–8, and was at Dettingen (1743), Fontenoy (1745), and Roncoux (1746); in the Seven Years' war beginning 1756 he was at the French victory of Hastenbeck, 1757. He had become noted as a brilliant soldier and ranked as lieutenant-colonel; in 1758 Pitt selected him to co-operate with Prideaux in conquering Canada from the French, made him major-general, and gave him command of the expedition against Louisburg, which he speedily reduced, 27 July. In the following September he superseded Abercromby as commander-in-chief of the English forces in America and captured Crown Point and Ticonderoga the following year. On 8 Sept. 1760 he captured Montreal and ended the French dominion in Canada. For this he was made governor-general of the British possessions in America, thanked by Parliament, and made a Knight of the Bath. But in face of Pontiac's conspiracy (1762) he failed,

as other English commanders had so often before, from insisting on conducting Indian like European warfare, and despising the American militia and American experience. But as American trivialities like Pontiac's war were unknown or unregarded in England, Amherst on his return in 1763 was received with immense enthusiasm as the conqueror of Canada; and as he was also a favorite of George III., and actively supported the policy of coercing the colonies through the years before the Revolution, his honors did not cease. He was titular governor of Virginia 1763-8, without going there, governor of Guernsey from 1770 on, privy councilor, 1772 on, 1772-82 and 1783-93 commander-in-chief of the British army, and was made a field marshal on resigning his command. In 1776 he was raised to the peerage. In 1780 he took an active and most humane part in suppressing the London "no popery" riots.

Amherst, port of entry and capital of Cumberland County, Nova Scotia, Canada, situated on an arm of Cumberland Bay, an extension of Chignecto Bay, the extreme northeastern arm of the Bay of Fundy; on the Intercolonial Railway, 138 miles north by west of Halifax, Nova Scotia, and about midway between that city and Saint John, New Brunswick. It was formerly called Fort Lawrence. Amherst is the centre of a rich agricultural and lumbering district; has factories, iron-foundries, tanneries, and ship-building establishments; and has an especially large trade in lumber and ship-building. Some of the richest coal mines in the Province are near here, and grindstones and gypsum are quarried in the vicinity. The county and railway buildings, the churches, and hotels are substantial structures. Amherst has a bank, and daily, semi-weekly, and weekly newspapers. Pop. (1901) 4,964.

Amherst, Mass., a town in Hampshire co., situated on the Boston & Maine and the Central Vermont R.R.'s, 23 miles northeast of Springfield. It has manufactories of paper, straw and palm-leaf hats, and leather, and is best known as the seat of Amherst College (q.v.), the State Agricultural College, and the State Experiment Station. Pop. (1900) 5,028.

Amherst College, at Amherst, Mass., one of the best known and most influential of New England colleges, though it has kept to the older ideals of an all-round liberal education, neither workshop nor professional school, and has not attempted to broaden into a university with specialized departments. As with all the earlier United States institutions of learning, the objects and impelling causes of its foundation were religious. It was started by an association of Congregational ministers who first took action in 1815, and was based on Amherst Academy, opened December 1814, and for many years one of the foremost academies in Massachusetts. The trustees of the academy were long the trustees of the college also, and the original plan was merely to endow a professorship of languages there to train educated ministers. They then enlarged it to a charity fund for "the classical education of indigent young men of piety and talents" for the ministry. A convention of the churches in western Massachusetts on 29 Sept. 1818 located the new institution at Amherst; the cornerstone was laid 9 Aug. 1820, and the institution opened 18 Sept. 1821. For some years the intention was to incorporate Williams College with it; but on a petition to the legislature permission to remove Williams was refused. The first president was Rev. Zephaniah Swift Moore, who died 29 June 1823 largely as a result of overwork. He was succeeded by Rev. Heman Humphrey, who retired in 1845, when the institution was threatened with bankruptcy, and its members and friends hardly expected to maintain it as anything more than an academy, and was succeeded by Rev. Edward Hitchcock, then professor of natural theology and geology there, and considered the foremost of American geologists. In his nine years' tenure he greatly extended the reputation of the college and saw it much more prosperous, and by his firm but conciliatory spirit, his weight of character, and sagacity of policy, gave it more internal unity and outside friendship. He resigned the presidency in 1854, but retained his professorship and was succeeded by Rev. William Augustus Stearns, who died in 1876: an able and excellent business man and administrator, and sound conservator of the college interests. His successor, Rev. Julius H. Seelye, who held office till 1890, placed it within its chosen boundaries alongside the best of other colleges: his reputation as scholar, publicist, educator, and humanitarian was more than national and drew the best class of pupils there. He resigned in 1890 from failing health, and has been succeeded by Merrill Edwards Gates to 1899, and Rev. George Harris, the present president. The college in 1902 had 36 professors and 410 students, and had graduated over 4,200 in all, of whom considerably over half had become clergymen or teachers. It had a library of over 75,000 volumes and very remarkable scientific museums; President Hitchcock's private collection of fossil footmarks, or ichnological cabinet, the choicest in the world, and his admirable geological and mineralogical cabinet, greatly supplemented by Prof. Benjamin K. Emerson, "a Mecca to geologists and savants"; the Adams conchological and the Shepard meteoric collections; also the collection of Indian relics presented by Edward Hitchcock, Jr. It has likewise the Pratt gymnasium and natatorium, athletic field, and college hospital, presented by the sons of Charles Pratt of Brooklyn, N. Y. Its income is about $110,000, and its scholarship fund has swelled by degrees to $300,000, the income of which goes to indigent students.

Alfred S. Goodale,
Registrar.

Amice, or **Amict** (Lat. *amictus*, girt around), a vestment worn by priests in the Roman Catholic Church during the celebration of mass. After the general adoption of the cravat had rendered the amice unnecessary as a neck-cloth, it was retained for the significance which it had acquired as an emblem of the cloth wherewith the Saviour was blindfolded by the Jews the night before his crucifixion.

Amici, Giovanni Batista, an Italian savant: b. in Modena, 1786; d. 1864. He studied natural history at Bologna, and mathematics at Modena. He became professor of mathematics at the college of Panaro, and for some time general inspector of education in Modena, where in 1831 the Grand Duke of Tuscany appointed

him director of the Florence observatory, as successor of the celebrated comet-discoverer, Luigi Pons. This office he held until his death, publishing every year the result of his astronomical observations, at the same time contributing important papers on natural history to the *Memorie della Società Italiana.* Science is especially indebted to him for his improvement of the telescope, of several microscopes, and of the camera lucida, invented by Hooke and Wollaston. He seems to have from his earliest life devoted much attention to optical instruments, and before he was 20 he made a telescope of a mixture composed by himself. In 1827 he made dioptric microscopes, which are sold with his name attached, and, notwithstanding the improved microscopes of Oberhäuser, are still in great favor. He was assisted in his labors by his son, Vincenzo Amici, who is professor of mathematics at the University of Pisa.

Amicis, Edmondo de, Italy's foremost 19th-century descriptive writer: b. Oneglia, of Genoese parentage, 21 Oct. 1846. Educated at Coni and Turin, he attended the Modena military school; entered service 1863 as sub-lieutenant, acted against the Sicilian brigands, and served through the Austro-Prussian war of 1866, being at Custozza 24 June. He remained in the army till the occupation of Rome in 1870; but his literary vocation was plain. In 1867 he took charge of a Florentine paper, *L'Italia Militare.* In 1868 his first volume, 'Military Sketches,' short stories of the phases of a soldier's life, had sweeping success and marked him as the coming Italian litterateur; and in 1871 he settled at Turin and devoted himself to authorship. His next work was 'Recollections' (of 1870–1), dedicated to the youth of Italy; a fresh collection of stories followed. But a craving for travel turned him into the path which has given him his greatest fame: the foreign world at least knows him mainly by the brilliant, glowing volumes describing the countries of Europe and other continents he visited, their national characteristics and habits, and, most of all, the springs of their life and thought. They are enthusiastic, sympathetic, optimistic, full of sensuous delight in beauty, rich in color, and vivid in clearness of portrayal; but they exhibit too a marvelously keen analytic power as well as acute photographic sensitiveness to impressions and marvelous literary skill in translating them into language. The greatest of these perhaps is 'Holland' (1874), a singularly fine analysis of the essence of Dutch life and the sources of Dutch art in that life; others are 'Spain' (1873), 'Recollections of London' (1874), 'Morocco' (1876), 'Recollections of Paris' (1878), 'Constantinople' (1878). He published also in these times 'Literary Portraits' (1881), sympathetic studies of Daudet, Zola, Dumas Jr., Augier, Coquelin, and Déroulède; 'The Friends,' on friendship in general (1882); historical novelettes, a collection in part old, entitled 'The Gate of Italy' (1884); 'On the Ocean' (1889). Later, educational and social problems deeply occupied his mind: his 'Cuore' (Hearts; Englished as 'The Heart of a Schoolboy'), a juvenile in which a pupil tells the events of a school year day by day, has sold nearly 200,000 copies in Italy; a novel for adults on similar lines is 'The Workmen's Mistress' (1895); followed the same year by 'The Romance of a Master' (1895), which has a strong socialistic bent. He avows himself that he thinks socialism the only available spring of a vital Italian literature now. His latest works are 'Everybody's Wagon' (1899), 'Memories' (1899), 'Hope and Glory' (1900), and 'Records of Infancy and School' (1901).

Amide (am'id; from *ammonia,* + *ide*), in chemistry, a general name for a class of bodies which may be regarded as derived from ammonia, NH_3, by replacing one or more of the hydrogen atoms in that substance by an equal number of monovalent acid radicals. Thus formic acid, H.CO.OH, may be regarded as a hydrate of the acid radical HCO; and the compound $HCO.NH_2$, which is known as "formamide," and is obtained by the action of ethyl formate upon ammonia, may be regarded as derived from ammonia by the substitution of the radical HCO for one of the hydrogen atoms in NH_3. Similarly, acetic acid, $CH_3.CO.OH$, may be regarded as a hydrate of the radical "acetyl" (C_2H_3O); and acetamide, which has the formula $C_2H_3O.NH_2$, and is produced by the action of ethyl acetate upon ammonia, may be regarded as derived from ammonia by the substitution of the radical "acetyl" for one of the hydrogen atoms in the ammonia.

Taking the general formula of a normal fatty acid as X.CO.OH, where X represents an alcohol radical (see ALCOHOL), an amide may be formed by substituting the monovalent acid radical, XCO, for one of the hydrogen atoms in NH_3. The resulting substance, $XCO.NH_2$, is called the "primary amide" of the acid radical XCO. By the further substitution of XCO for one of the atoms of hydrogen remaining in the primary amide, a "secondary amide" of the same acid radical is obtained, having the formula $(XCO)_2.NH$. It is evident that a "tertiary amide," having the formula $(XCO)_3.N$, is also possible.

For some purposes it is convenient to regard the primary amide, $XCO.NH_2$, of the monobasic acid X.CO.OH, from the opposite point of view; namely, as derived from the acid by the substitution of the radical NH_2 for the hydroxyl group OH. Obviously the result is the same in either case; but this latter view makes the deportment of dibasic acid radicals easier to describe. Thus in the dibasic acid $Y(CO.OH)_2$ (where Y is a divalent radical), the first result of the substitution of NH_2 for OH is the formation of the body $Y(CO.OH).(CO.NH_2)$, which is both an acid and an amide,— an amide because it is obtained by the substitution of NH_2 for OH, and an acid because it still contains one molecule of hydrogen that is replaceable by a monovalent metal or radical (namely, the molecule of H in the OH). Bodies of this type are called "amic acids."

If the molecule of OH remaining in an amic acid is replaced by a further substitution of NH_2, the resulting substance, $Y(CO.NH_2)_2$, is called a "di-amide," and may be regarded as formed from two molecules of ammonia by the substitution of the divalent acid radical $Y(CO)_2$ for one third of the total hydrogen present in those molecules.

The chemistry of the amides is very involved. They are mostly solid bodies, neutral to litmus, but capable of forming compounds with acids. The most familiar example of the class is the primary amide of acetyl, or "acetamide." This

substance, which is usually obtained by the dry distillation of acetate of ammonium at temperatures exceeding 375° F., has the formula $C_2H_3O.NH_2$, as noted above, and forms hexagonal crystals. It melts at about 180° F., boils at about 432°, and is quite soluble in water. Diacetamide, $(C_2H_3O)_2.NH$, and triacetamide, $(C_2H_3O)_3.N$, are also known. See AMINE; IMIDE; NITRILE.

Amido Acids, intermediary products in the metabolism of proteids. In the process of digestion notably, the proteids (albumens) undergo a gradual series of transformations whereby the complex proteid molecule is broken down into simpler and simpler compounds, until at the end of the process carbonic anhydride, water, urea, uric acid, ammonia, etc., are the results. While these end products of metabolism are well known, the intermediary products are the object of much inquiry. In the intestinal canal, under the prolonged action of the pancreatic juice ferments, simpler nitrogenous principles are found, leucine, tyrosine, aspartic acids — these belong to the general group of the amido-acids. Schutzenberger has described amido-acids of the (1) leucine class, $C_NH_{2N+1}NO_2$ — such as alanine, propalinine, butalanine; (2) of the acrylic series $C_NH_{2N-1}NO$, (3) amido-acids of the gluco-protein class, sweet in taste, with the general formula $C_NH_{2N}N_2O_4$; (4) amido-acids such as tyrosine, tyroleucine, and glutaminic acid. References: 'Text-book of Physiology,' Schäfer, Vol. I., p. 30.

Amiel, Henri Frederic, a distinguished Swiss essayist, philosophical critic and poet: b. in Geneva, 27 Sept. 1821; d. there 11 March 1881; was for five years a student in German universities, and on his return home became professor of philosophy in the Geneva Academy. He is author of several works on the history of literature, as 'The Literary Movement in Romanish Switzerland' (1849); 'Study on Mme. de Staël' (1878); and of several poems, among them 'Millet Grains' (1854). But his fame rests principally on the 'Journal,' which appeared after the author's death.

Amiens, ȧ'myăɴ', an old French city, once the capital of Picardy, and now of the department of Somme, on the many-channeled navigable Somme, 81 miles north of Paris by rail. Its fortifications have been turned into charming boulevards, but it still retains its old citadel. The Cathedral of Notre Dame is a masterpiece of Gothic architecture. Begun in 1220, or a little later than Salisbury Cathedral, it is 470 feet long, and has a spire (1529) 426 feet high; but its special feature is the loftiness of the nave, 141 feet. In his little work called 'The Bible of Amiens,' Ruskin says this church well deserves the name given it by Viollet-le-Duc, "the Parthenon of Gothic architecture," and affirms that its style is "Gothic, pure, authoritative, and unaccusable." Other noteworthy buildings are the Hôtel de Ville (1600–1760), in which the Peace of Amiens was signed; the large museum (1864), in Renaissance style; and the public library, founded in 1791 and containing 70,000 volumes. Amiens has considerable manufactures of velvet, silk, woolen, and cotton goods, ribbons, and carpets. Peter the Hermit and Ducange were natives, and there are statues to both of them. The "Mise of Amiens," was the award pronounced by Louis IX. of France, in 1264, on the controversy between Henry III. of England and his people as to the "Provisions of Oxford." The Peace of Amiens (27 March 1802) was a treaty intended to settle the disputed points between England, France, Spain, and Holland. By it England retained possession of Ceylon and Trinidad and an open port at the Cape of Good Hope; the republic of the Ionian Islands was recognized; Malta was restored to the Knights of St. John; Spain and Holland regained their colonies, with the exception of Trinidad and Ceylon; the French were to quit Rome and Naples; and Turkey was restored to its integrity. In the Franco-Prussian war, on 27 Nov. 1870, General Manteuffel inflicted, near Amiens, a signal defeat on a French army 30,000 strong, and three days later the citadel surrendered. Pop. (1903) about 92,000. For a recent account of the cathedral see T. Perkins' 'The Cathedral of Amiens' (1902).

Amina, the sleep-walking heroine of Bellini's opera 'La Sonnambula.'

Amine (am'in; from *ammonia* + *ine*), a general name for a compound formed by replacing one or more of the hydrogen atoms of ammonia by an equivalent number of metallic atoms or basic organic radicals. (Compare AMIDE.) As in the case of the amides, a given monovalent radical can form three compounds of this sort according as it replaces one, two, or three of the hydrogen atoms of the original ammonia. For example, the monovalent basic radical "ethyl," C_2H_5, forms primary ethyl amine (or "ethylamine"), $C_2H_5.NH_2$, when it replaces one atom of H in NH_3; secondary ethyl amine (or "diethylamine"), $(C_2H_5)_2.NH$, when it replaces two atoms of H; and tertiary ethyl amine (or "triethylamine"), $(C_2H_5)_3.N$, when it replaces all three of the hydrogen atoms in the ammonia. The base by which the hydrogen in the ammonia is replaced need not be organic. Potassium, for example, may replace an atom of it, with the formation of potassium monamine (or "potassamine"), $K.NH_2$. A derivative of ammonia, in which one atom of the typical hydrogen is replaced by a monovalent acid radical, and another by a monovalent basic radical or by a monad metal, may be considered to be either an amine or an amide. Thus $CH_3.C_2H_3O.NH$, in which one atom of the hydrogen has been replaced by the basic radical "methyl" (CH_3), and another by the acid radical "acetyl" (C_2H_3O), may be described as a modified methylamine, or as a modified acetamide.

The simpler amines are strongly basic in character, and may be formed by the action of ammonia on the ethers of inorganic acids. They are mostly volatile or capable of distillation. When ammonia is added to a cold solution of a salt of an amine, the amine is expelled from its combination and precipitated.

The most important amines, in the arts, are methylamine (q.v.) and aniline (q.v.).

Amirante Islands, a group of small islands in the Indian Ocean, lying southwest of the Seychelles. They were taken possession of by Great Britain in 1814 and form a dependency of Mauritius. They produce cocoa-nuts, and turtle and fish are abundant. About six are inhabited.

Amis et Amiles, a'me' za a'mel', a chanson of the Middle Ages, dating from about the beginning of the 13th century. The work con-

sists of 3,500 lines, in which are narrated the adventures of two friends.

Amistad Case, in United States history, one of the landmarks of the slavery question. The Spanish government, by decree of December 1817, forbade the importation of slaves from Africa into its dominions after 30 Dec. 1820, on penalty of confiscation of the slave-ship and immediate freeing of the negroes. The trade nevertheless went on under transparent disguises. In the spring of 1839 the slave-hunters in Africa made a large capture of Sierra Leone natives, including their chief Cinque, and sent them to Havana; where two months afterward two Cuban planters, Pedro Ruiz and José Montez, bought 38 youths and men, three girls, and a boy, and shipped them on 27 June for Guanaja, Puerto Principe, on the schooner L'Amistad, under passport from the governor of Cuba obtained by falsely alleging that they were domestic slaves. Cinque organized a plan for revolt, and when four days out they rose, killed the captain and one of the crew, wounded two others in the contest, and forced the remaining whites to surrender; but they did them no violence, and set all on shore except the two planters, whom they managed to make understand that they must steer for Africa. These gradually changed course in the nights and fogs, and brought the vessel north off Culloden Point (near Montauk), at the east end of Long Island, where on 26 August she was noted as "suspicious" by Lieut. Gedney of the coast survey, on the brig Washington. He sent a boat to her, and one of the planters declared himself the owner of the negroes and claimed United States protection. Some of them had gone on land in a boat; Gedney seized them as under New York State jurisdiction, and the vessel as a "prize rescued from pirates," and brought them to New London, Conn. The negroes were committed for murder on the high seas, to be tried at the circuit court of 17 September at Hartford, and meantime lodged in New Haven jail. The planters claimed them as slaves, appealed to the Spanish minister Calderon, and he demanded their surrender of the United States district attorney for Connecticut. The latter wrote to the secretary of state (Forsyth of Georgia) asking if the negroes under treaty with Spain might not be surrendered before the court sat; the secretary transmitted the question to the President (Van Buren), but warned the district attorney to take care that no court whatever put the vessel, cargo, or slaves (*sic*) beyond the control of the Federal executive. Meantime the anti-slavery interest had bestirred itself and secured funds, able counsel, and an interpreter of African; and the circuit court (Judge Thompson) decided on the 23d that the killing of the captain of the L'Amistad, being an incident of the slave trade, was not a crime against the law of nations. The negroes were remanded to jail till the district court in November should decide whether they were free or slave. The next day the United States attorney-general, Felix Grundy of Tennessee, was ordered to prepare an official opinion on the Spanish minister's request and the claim of Gedney *et al.* for prize money. He replied in November that ship, cargo, and negroes should be surrendered according to Art. 9 of the treaty of 27 Oct. 1795, as the United States under international law had no power to investigate the truth of facts stated in Spanish official papers,— in other words, whether the governor's passport was obtained by fraud, and the negroes were free according to the Spanish law already cited; though hardly one could speak a word of European and none much more, and the planters were obviously perjured in swearing ignorance of their being recently imported. But this article any way related only to vessels and goods rescued on the high seas from pirates; and under this interpretation the negroes were at once the pirates and the cargo, and had committed piracy in seizing themselves from their owners. The Spanish minister protested that no United States court had any jurisdiction. The administration, not daring to take the case out of its courts, went as far as it could by ordering the district attorney to act as legal adviser to the planters and file another indictment for them with new pleadings; sent a vessel to lie off New Haven in order to carry the negroes back to Cuba as soon as the district court pronounced them slaves, as was taken for granted (this was the first trial for violating the slave-trade laws that had taken place except in slave States, where of course no convictions were ever found), and to do it instantly unless an appeal were interposed, which was "not to be taken for granted"; ordered that Gedney and his associate Meade accompany it to give evidence in court; and that these directions be kept secret. But the anti-slavery counsel had no difficulty in showing that kidnapping foreigners was not only not protected by United States or even Spanish law, but was directly contrary to both (the anti-slavery doctrine outside the courts was that the kidnapped had a natural right to kill their captors if they could, and a legal right to hold ship and cargo as prize in such case, and the United States had no right to interfere); and the court pronounced them free, and ordered them delivered to the United States executive to be sent back to Africa. The plaintiffs at once appealed to the supreme court, and the administration continued its partnership in a private suit. The case of the negroes was argued in February and March 1841 by John Quincy Adams, who had previously introduced resolutions into the House directing the President to report to Congress the authority by which Africans charged with no crime were held in custody; Roger Sherman Baldwin, the district attorney, admitted in open court that they were newly from Africa when bought: and on 9 March the court (Taney, C. J.) pronounced them illegally held as slaves and liable to no punishment for their acts. The case roused the fiercest excitement in both the free and slave sections of the country. In 1844 the astounding bill was reported by the chairman of the House committee on foreign affairs to pay Ruiz and Montez $70,000 compensation; but it was laid on the table and never reappeared. This ends the "case," but a word may be added on the negroes. They were removed to Farmington, Conn., well cared for, and instructed in the rudiments of education by a competent professor. Cinque kept them under stern discipline; they were excellently behaved and much liked; and some of them, being unusually quick of intelligence, were exhibited for proficiency in New England towns. About the end of November they were sent back to Africa with some missionaries, and a mission was afterward established in the district.

Amitosis. See MITOSIS.

Amlwch (pronounced *Amlook*), a seaport town in North Wales, on the north coast of the island of Anglesey, and 14 miles northeast from Holyhead. The harbor is partly cut out of the solid rock. There are copper mines near the town, and mining is said to have been carried on here by the Romans. Pop. (1901) 5,308.

Ammanati, Bartolomeo, a sculptor and architect: b. Florence, 1511; d. 1592. His chief work was the Trinity bridge over the Arno at Florence.

Ammen, Daniel, American naval officer: b. Brown County, Ohio, 15 May 1820; entered the United States navy 7 July 1836 as midshipman. He was in the Wilkes exploring expedition around the world 1838–42, in the East India squadron, and on the coast survey; on the expedition to the Paraguay River 1853–4. He commanded the Seneca at the capture of Port Royal, 7 Nov. 1861; promoted to commander 21 Feb. 1863; in charge of the Patapsco at the assault on Fort Macallister, 3 March 1863, and on Fort Sumter, 7 April; commanded the Mohican in the attacks on Fort Fisher, December 1864 and January 1865. He was commissioned captain 1866, was chief of the bureau of yards and docks 1869–71, and of the bureau of navigation till 11 Dec. 1877, when he was made rear-admiral on the retired list. He designed the Ammen life raft and the ram Katahdin. He wrote 'The American Inter-Oceanic Ship Canal Question' (1880); 'The Atlantic Coast,' (1883); 'Country Homes and their Improvement'; 'The Old Navy and the New' (1891).

Ammergau, am'mer-gou, a district or *gau* on the river Ammer in Upper Bavaria. The inhabitants are occupied in making figures of saints, crucifixes, toys, etc., of wood, ivory, and glass, from which a considerable trade arises, having its centre in the villages of Ober and Unter Ammergau. The former village is famous on account of the Passion Play (q.v.).

Am'meter. See GALVANOMETER.

Ammon, an Egyptian deity, whose worship spread all over Egypt and other parts of north Africa, and many parts of Greece. The Egyptian hieroglyphic monuments call him Amun, the Greeks identified him with their supreme god Zeus, while the Romans regarded him as the representative of Jupiter. His worship centred in the Egyptian Thebes, which the Greeks therefore called Diospolis or the City of Zeus. He is represented as a ram, as a human being with a ram's head, or simply with the horns of a ram. His most celebrated temple was in the Oasis of Siwah in the Libyan desert.

Ammonia (supposed to be so called because originally prepared from the dung of camels near the temple of Ammon, in Egypt), a gaseous compound of hydrogen and nitrogen, having the formula NH_3. It may be formed in small quantities by the direct combination of its elements under the influence of the silent electric discharge; but in the arts it is commonly prepared by the decomposition of nitrogenous matter. Formerly it was manufactured in large quantities by the destructive distillation of horns, hoofs, and hides, and from this fact it was known as "spirits of hartshorn." It is now chiefly obtained as a by-product in the manufacture of coal-gas. Coal suitable for the manufacture of gas contains nitrogen, often to the extent of 2 per cent of its weight; and in the distillation of such coal the nitrogen combines with a portion of the hydrogen that is also present, and is driven off in the form of ammonia; or more often it combines with the sulphur present and is obtained in the form of a sulphate. Salts of ammonia also occur in nature, sometimes in considerable quantities. In Tuscany ammonia sulphate is obtained as a by-product in the manufacture of boric acid. See BOUSSINGAULTITE; LARDERELLITE; MASCAGNITE.

Ammonia (NH_3) is a colorless gas at ordinary temperatures and pressures, but at 60° F. it condenses into a colorless and expansible liquid upon the application of a pressure of about seven atmospheres. At the freezing point of water a pressure of 4.4 atmospheres suffices to liquefy it; and at about 29° below zero, F., it condenses into a liquid at ordinary atmospheric pressure. Ammonia thus liquefied by pressure is much used, in the arts, for the production of low temperatures and the manufacture of artificial ice. (See REFRIGERATION, *Artificial.*) It freezes at about 103° below zero, F., into a white crystalline solid. Liquid NH_3 dissolves the alkali metals without chemical change, forming blue solutions.

Ammonia gas is very soluble in water at ordinary temperatures, the solution constituting the so-called "ammonia" or "aqua ammonia" that is familiar in every household. At 32° F. and at ordinary atmospheric pressure water will absorb 1,148 times its own volume of NH_3; and at 68° F. it will absorb 740 times its own volume.

Both ammonia gas and its solution in water possess strongly alkaline properties, turning red litmus paper blue and combining with acids to produce definite salts. The solution of ammonia gas in water is attended by a considerable development of heat, and it is usual to consider that a definite compound of ammonia and water is formed. The formula of this compound may be written $NH_3.H_2O$, but many considerations suggest that $NH_4.OH$ is a better and more logical form. NH_4 is here considered to be a radical, analogous in its chemical deportment to the familiar alkali metals sodium and potassium. According to this view ordinary "aqua ammonia" would be regarded as a solution of the hydrate of the radical NH_4; and for many years past chemists have admitted the existence of such a radical, which they have called "ammonium." Upon adding hydrochloric acid to a solution of ammonia gas, a compound known as "sal ammoniac" is obtained, which is used largely in electric batteries that are intended for open circuit work. The reaction by which this substance is formed may be written $NH_3 + HCl = NH_3.HCl$; or if the existence of a definite hydrate in the "aqua ammonia" is admitted, we may write the reaction $NH_4.OH + HCl = NH_4.Cl + H_2O$, in which case the reaction is in all respects analogous to that by which potassium chlorid (for example) is formed when hydrochloric acid acts upon potassium hydrate: $KOH + HCl = KCl + H_2O$. All the other salts that are formed by the combination of ammonia with acids can be similarly expressed by admitting the existence of the radical NH_4 and treating it, in the formulæ, as though it were a metal of the alkali group. All the "ammonium" compounds are isomorphous with the corresponding potassium compounds.

Aqua ammonia, or "caustic ammonia" (as it is sometimes called), is used for many purposes in the arts, notably in the production of soda by the ammonia process (see SODIUM), and in dyeing and calico-printing. Large quantities of the sulphate are used in fertilizers and in the manufacture of ammonia alum (see ALUM). The chloride of ammonium is used (as above noted) in certain common forms of electric batteries, and also in soldering, in dyeing, and in many minor ways. The carbonate is largely used in the manufacture of baking powders and for scouring wool.

Ammonia is expelled from all of its compounds by quicklime, and the usual test for ammoniacal compounds consists in heating the substance to be examined, together with caustic lime or caustic soda or potash. If ammonia is present in any considerable amount it is liberated by this treatment and may be recognized by smell or by its action on litmus paper. Nearly all of the compounds of ammonia are readily soluble in water, the acid tartrate and the double platinic chloride being the chief exceptions.

Ammonia forms the starting point for an extraordinarily long list of compounds, many of which are exceedingly complicated. See AMIDE; AMINE.

Am'moni'acum is a gum resin derived from the stems of *Dorema ammoniacum,* a forest plant of Persia. Other species of *Dorema* yield similar products.

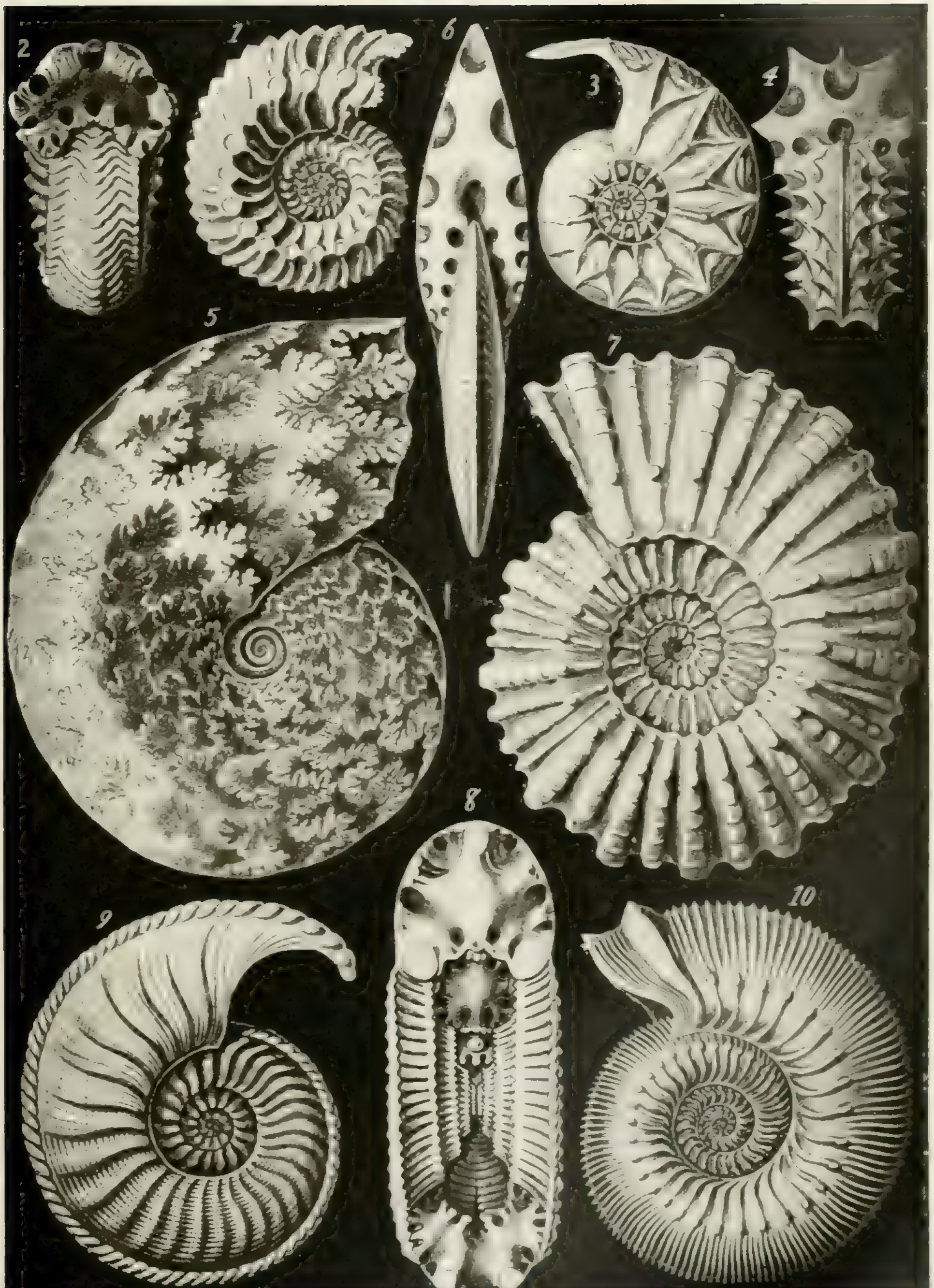
The plant has an abundant supply of milky juice which exudes spontaneously and hardens in various-shaped masses. Fine tears, varying in size from two to five mm. up to the size of a hazel-nut are obtained from insect-punctured wounds, while the so-called *ammoniacum amygdaloides* is obtained from the root of the plant.

Ammoniacum consists of a mixture of varying proportions of ethereal oils, 1 to 2 per cent, resins, gums, 65 to 70 per cent; and pectin-like bodies. Ash 20 per cent. A certain amount of water is always found in the commercial product. The ethereal oils are found in small quantities only, generally less than 10 per cent. It is soluble in carbon disulphide. The resin is to be distinguished from other resins in that its alcoholic solution gives a red reaction when added to a bromide of sodium solution, 30 gr. NaOH in Aq. Br. 20 gr. Aq. 1 liter. Umbelliferon would seem to be absent.

Ammonites, or "children of Ammon." In the cuneiform inscriptions their land is called Bit-Ammān, as if Ammān were a personal name; but Genesis says Ben-ammi, and Ammi was perhaps a local god. Their land was in the eastern part of the district now called Belka, on the northeast of the Dead Sea next the desert; its capital Rabbah or Rabbath-Ammon. Their real history begins with Saul, though Jephthah the freebooter is said to have delivered Israel from them, and one tradition represents Balaam as an Ammonite — but this is thought a later excuse for excluding them from the Jewish body. They were in a state of chronic border warfare with the Hebrews, their close kinsmen, and speaking a closely related dialect. Nahash, king of Ammon, besieges Jabesh-Gilead (1 Sam. xi.), and offers terms for its capitulation on condition of putting out the chief men's right eyes,— but Saul wins a crushing victory over the besiegers. David as Saul's enemy is well treated by Nahash; but when he takes Saul's place the old feelings are resumed. Hanun, the son and successor of Nahash, treats David's messengers of congratulation with gross contumely (2 Sam. x.); David wins a victory over them and the Syrian allies they have called in, and exacts a frightful vengeance from them, putting his captives to the torture quite in the Assyrian fashion, and leaving us to infer that there was little to choose in savagery. They probably recovered their independence after Solomon's death. Later they were subjugated by the Assyrians, as the inscriptions of several kings evince. Under Jeroboam II. they make incursions into Gilead and are blamed for inhumanity. After the Israelitish deportation of 734 they occupied the land of Gad; under Jehoiakim they are incorporated into Judah; under Zedekiah they are allied with him against Assyria, but seem to have drawn out in time for safety, and Israelitish fugitives find refuge with their king Baalis. Later they intermarried with the Jews, and there was a village of them in Benjamin; Judas Maccabæus defeated them; but they were gradually absorbed by invading Arab tribes. Their great local god was Milcom.

Ammonites, the general name for the fossil cephalopod mollusks of the order *Ammonoidea,* given originally because of a fancied resemblance of the coiled specimens first known to a ram's horn, the symbol of Jupiter Ammon. Subsequently it served as a generic name for a group, but this has been abandoned in the light of later information. The *Ammonoidea* are one of the two orders of chambered tetrabranchiate cephalopods, the other being the *Nautiloidea* (see NAUTILUS). Their remains are found fossil in marine Palæozoic rocks from the Devonian to the close of the Mesozoic Age. More than 5,000 species have been described, grouped into about 100 families, and these into nine sub-orders in two divisions, (1) *Intrasiphonata* and (2) *Extrasiphonata.* The first group contains a single primitive (Devonian) sub-order having the siphuncle dorsally situated; the second contains all the remainder, which agree in having the siphuncle ventral. The classification is based upon the complexly lobed pattern of the sutures, or lines of union between the septa or partition walls of the chambers and the outer wall of the shell. (See CEPHALOPODA.) The shells of ammonites were typically coiled in a single plane and ran in size from an inch or two in diameter to two or more feet; but this varied greatly, even to partial or entire straightness. The surface of the shell, too, was in many cases smooth and polished or slightly ridged, while in others it was roughly ringed or covered with cross-lines, spikes, and tubercles, in handsome variety. Some shells were so compressed as to have the proportions of a watch; while others were almost globose.

As Hyatt states, ammonoids experienced a progressive evolution from the early Devonian until the upper Juras, when the group reached its summit of importance and was represented in great numbers and variety in all parts of the world: that is, when it attained the summit of its evolution in complexity of structure, form, and ornament. Ammonoids exist in great abun-



AMMONITES.

1, 2 **Ammonites cordatus.** 3, 4 Ammonites Coupei. 5, 6 Ammonites opulentus. 7 **Ammonites mammillaris.**
8 Ammonites cavernosus. 9 Ammonites rotula. 10 Ammonites Humphryi.

dance in the rocks of this period in the western United States, especially those of the irregular group called Ceratites, which succeeded the Palæozoic Goniatites, and other primitive forms. The Jurassic ammonoids show a mixture of retrogression with some progressive features. "Part of their losses are regained by the evolution of the vast number of forms and modifications during this period, but there are numerous localized signs of retrogression, due perhaps to unfavorable surroundings." Indications of this kind occur sporadically throughout the Jurassic time and become general in the Cretaceous period. Many of the later forms were openly or grotesquely coiled, or coiled only when young, becoming nearly or quite straight when they grew older, as in Ptychoceras, Turriteles, Scaphites, etc. These degraded "old-age" types were evidently due to the waning forces of life or to disease, because similar though much less marked uncoiling of shells, due to unfavorable condition of the water, have been observed in the fresh-water Planorbis of Steinheim, Germany, and elsewhere. (See EVOLUTION; SENESCENCE.) Hyatt thus infers that there was in the European seas, at least, a widespread unfavorable change in their physical surroundings, "similar to but more extensive than that which affected European forms during the Lower Oolite," and to this influence he ascribes the uncoiling of the shells of Spiroceras and its allies. At the close of the Cretaceous period the ammonoids entirely disappeared. We thus see in the vast and more or less complete and continuous series of these beautiful shells, in which the imperfections of the geological record are less marked than in other groups, the process of rise, culmination, decline, and death of a type, presenting also beautiful illustrations of the biogenetic law (q.v.). The type begins with infantile and larval forms, then evolves youthful, mature, and finally old age forms, which present in their simple and closely coiled shells a return to the original simplicity of the infancy and childhood of the type.

Concerning the animals which made the shells, nothing is known except by inference. The growth of the shell begins with the formation of the primitive conically-shaped shell called "protoconch," and then the secondary shell begins to grow and becomes coiled up in one plane. Like the nautilus the mollusk lived in the outer chamber of its shell, from which it periodically advanced. The aperture of this outer chamber was closed when the animal withdrew into it, either by a single horny plate (*anaptychus*) or by a pair of calcareous plates (*aptychus*). The very earliest appear to have been swimmers, like the nautiloids; but the great bulk of the ammonites undoubtedly lived gregariously alongshore, where they crawled about, carrying or partly dragging their shells, and searching for the animal food upon which they subsisted. The learned Zittell points out that their shells were proportionately less bulky than those of the nautiloids, and correspondingly less buoyant; and the probability is that they swam little and were rarely active. There is reason to believe that in the case of some species the eggs were retained within the shelter of the living-chamber until they hatched, and that the young remained there until somewhat grown. See GONIATITES.

Bibliography.— Cook, 'Cambridge Natural History. Mollusks' (1895); Zittell-Eastman, 'Text-book of Palæontology,' Vol. I. (1900); Hyatt, 'Genesis of the Arietidæ' (Memoirs Mus. Comp. Zool., Vol. XVII., 1889); 'Phylogeny of an Acquired Characteristic' (Proc. Amer. Philos. Society, Vol. XXXII., No. 143, 1894); Wurtenberger, 'Studien über die Stammesgeschichte der Ammoniten' (Leipsic 1880), and numerous other papers; also articles by D'Orbigny, Neumayr, Pumpelly, Quenstedt, Sandberger, Suess, Waagen, White, Whiteaves, Wright and Zittel.

Ammo'nius Sac'cas, a Greek philosopher who lived about 175–250 A.D. Originally a porter in Alexandria, he derived his epithet from the carrying of sacks of corn. The son of Christian parents, he abandoned their faith for the polytheistic philosophy of Greece. His teaching was historically a transition stage between Platonism and Neo-Platonism. Among his disciples were Plotinus, Longinus, Origen, etc.

Ammonoosuc, the name of two small rivers in New Hampshire which rise in Coos County and flow in a southwest direction, emptying into the Connecticut River. The lower Ammonoosuc is about 100 miles long and the upper 75 miles long.

Ammophila, a grass common on sandy beaches, a coarse perennial, with running rootstocks. It is of value as a binder of loose sand and is employed for that purpose throughout the world, its destruction being forbidden in England under severe penalties.

Ammunition, the articles which are required in firearms and ordnance to render the mechanism effective. From the earliest period of settlement shot and bullets have been made by Americans. Lead was brought with them from England and Holland, and cast in molds, many of which are still preserved in old houses in New England, Pennsylvania, and Virginia. They differed only in size, so whether each projectile weighed an ounce or the twentieth of an ounce, the same plan was adopted. Shot-towers were invented at an early date. The metal, a compound of lead and arsenic, the latter forming one hundredth part, is melted at the top of a high tower and poured into a colander. The lead passes through in drops instead of streams, each assuming a perfectly spherical form, and falls into a basin of cold water, there being instantly chilled in the globular form. After this the shot are rolled down an inclined plane, those which are not truly spherical falling off at the sides, while the perfect ones continue in a direct course. The holes through which the liquid metal passes are from one thirtieth to one three hundred and sixtieth of an inch in diameter. Shot is much used for killing small game, which would be torn in pieces by a heavy bullet; and a shot-gun also requires less accurate marksmanship than a rifle. Bullets are still cast in molds, but in the factories this operation is performed with great celerity. The ridge caused by the meeting of the two parts is automatically removed by a knife. Swaging of bullets is also practised. The total quantity of shot made in New York annually is valued at $400,000, there being three shot-towers. Early in the 19th century no method was commonly known of getting

accurate results from a gun, but it was noticed that a bullet was nearly always flattened or smashed at the end nearest the powder. If the ball was large for the bore of the gun it reached its mark more certainly than if the bore was large. It was therefore the common practice for hunters to put a patch or wad around their bullet, which prevented the powder from falling out, and also kept the bullet straight till it had left the muzzle; and it was also discovered that if there were grooves inside the barrel which twisted more or less, a rotary motion was imparted to the bullet, which added much to its range and its powers of reaching its aim. This constituted the rifle, and after its method of construction became generally known no other weapon was used for hunting large game. They were used to some degree in armies even fifty years ago. Gradually the smooth-bore musket was driven out and soldiers were supplied alone with rifles. But another article was necessary before this could be completely accomplished. Until the second quarter of the century the fire which was required to be communicated to the powder came from a blow of the hammer of the gun upon a piece of flint. Frequently there was a miss. Percussion-caps were introduced about this time. They depended for their value upon the quality of igniting with a blow, their shape, like that of a cup, being only requisite in order to keep them on the nipple of the gun. They were much more certain in action than the flint had been, and soon drove it out everywhere. A later improvement in ammunition was by the introduction of cartridges, the powder and bullet being together. The metallic cartridge is an invention made in France about 1831 and introduced here shortly after. A great improvement was also made in France in 1845 in the shape of the bullet, which did not become known here till the time of the Crimean War. It was the Minié bullet, having for its peculiarity an elongation of the projectile. Hitherto all others had been round. The part which was foremost tapered to a point, but the rear was flat, as if the bullet had been cut from a round rod of lead. A heavier bullet was thus attained, a more thorough rotation was imparted, and little resistance was experienced from the air. The new projectile would carry twice the distance of the one it superseded, and would even at that point be more destructive. The total production of ammunition in the United States in 1900 was valued at $6,538,482; business was carried on in 35 establishments, which had 2,267 workmen, paid $1,110,482 in wages, and used materials valued at $4,645,850. See ARMAMENT OF THE WORLD; FIRE-ARMS; ORDNANCE.

Amnesia. See APHASIA.

Amnesty, an act of oblivion passed after an exciting political period. Express amnesty is one granted in direct terms. Implied amnesty is one which results when a treaty of peace is made between contending parties. Amnesty and pardon are very different. Amnesty is an act of the sovereign power, the object of which is to efface and to cause to be forgotten a crime or misdemeanor. A pardon is an act of the same authority which exempts the individual on whom it is bestowed from the punishment which the law inflicts for the crime he has committed. 7 Pet. (U. S.) 160. Amnesty is the abolition and forgetfulness of the offense; pardon is forgiveness. A pardon is given to one who is certainly guilty or has been convicted; amnesty, to those who may have been so.

Amnesty Proclamation. An act passed 25 Dec. 1868, granting amnesty to all who were guilty of treason against the United States or adhered to their enemies during the Civil War. This included domiciled aliens. But the proclamation did not entitle one whose property had been sold under the Confiscation Act of 1862 to reclaim the proceeds after they had been paid into the treasury of the United States.

Amnion. See FŒTUS.

Amœba, or PROTEUS ANIMALCULE, a protozoan classified as one of the rhizopods, which is present almost everywhere in fresh water, and sometimes in moist earth, and is commonly taken as the type of the unicellular animals. It is a mere drop of animated jelly (protoplasm, q.v.), hardly visible to the unaided eye, which under the microscope is seen to be divisible into an inner granular mass (endosarc) and an outer clearer part or envelope (ectosarc); but there is no essential difference in substance between them. Imbedded in the interior granules is a large spherical globule, the nucleus, consisting of a clear chromatic substance containing minute granules of chromatin. A contractile vacuole lies in the ectosarc, and manifests more or less regular and rythmical expansions and contractions; this seems to serve the purpose of an excretory organ. The amœba continually throws out irregular threads and extensions (pseudopods), so that its shape is more often like that of a drop of any thick liquid which has fallen and spattered, than of a globule; this shape is changing incessantly as the creature slowly creeps about. Whenever it touches any edible particle of organic material it slowly enfolds it, and the particle sinks into the body, where it is gradually dissolved, its nutritive material is digested and assimilated, furnishing food and fuel to the protoplasm, and the innutritious parts are finally gathered into the vacuole, whence they are squeezed out and discarded.

Amœba reproduces itself by a simple process of division. A constriction takes place at a point where the nucleus will be divided, and goes on until the animal becomes dumbbell-shaped. Finally the two parts separate, and each becomes a distinct and perfect whole, each with its half of the original nucleus, which at once becomes, in each case, a whole nucleus. After a time these individuals in turn undergo a similar division, and so on. It may therefore be said that amœba never ceases to exist — never dies; but simply multiplies indefinitely by repeated divisions.

Certain forms of *Amœba*, notably *A. coli*, are the cause of a distinct kind of dysentery now termed amœbic dysentery. This is a disease mostly of the tropics, but is also found endemic in the United States. Occasionally the parasite may infect the liver, causing an abscess in that organ. The disease is difficult to treat.

Amor, the god of love among the Romans, equivalent to the Greek Eros. He had no place in the national religion of the Romans, who derived all their knowledge of him from the Greeks. According to the later mythology Amor is the son of Venus and Mars, the most beautiful of all the gods; a winged boy with

bow and arrows, sometimes represented blindfolded. His arrows inflict the wounds of love, and his power is formidable to gods and men. He is not always a playful child in the arms of his mother, but appears sometimes in the bloom of youth, for example, as the lover of Psyche. He is brother of Hymen, the god of marriage, whom he troubles much by his thoughtlessness. According to the earlier mythology he is the oldest of all the gods, and existed before any created being. In English the god of love is less frequently called Amor than Cupid; yet with the ancients *cupido* denoted, properly, only the animal desire.

Amor'go (ancient *Amorgos*), an island in the Grecian Archipelago, one of the eastern Cyclades, 22 miles long, five miles broad; area, 106 square miles; has a town of the same name, with a castle and a large harbor. Pop. 5,000.

Amorites. Though made a separate tribe in the varied and rhetorical lists of the peoples in Canaan ousted by the Israelites, the name is used by Amos in the 8th century as a general term for the primitive inhabitants of Canaan, with attribution of gigantic size and power, as most old nations do with their special aboriginal predecessors. Some critics think, however, that "Canaanite" is used for the peaceful settlers of the plains, and "Amorite" for the warlike tribes on the hills to the north. At any rate, the latter term is always used when hostile tribes are meant. Moses' foes include Sihon and Og the Amorite kings, and Joshua deals with 12 kings of the Amorites west of the Jordan. The Amarna letters show that the coast as far north at least as Sidon was called Kinahi (Canaan), and perhaps the Amorites were the people of the interior; but the usages may be due to the writers coming from different sections.

Amory, Blanche, a shallow, selfish, worldly girl in Thackeray's novel 'Pendennis.'

Amory, Robert, physician: b. Boston 3 May 1842. He graduated at Harvard 1863, M.D. 1866, and studied in Paris and Dublin. He was lecturer at Harvard on the physiological action of drugs 1869; then professor of physiology at Bowdoin Medical College till 1874. Author of 'Bromides of Potassium and Ammonium' (1872); 'Action of Nitrous Oxide' (1870); and important papers on 'Chloral Hydrates,' 'Pathological Action of Prussic Acid,' and 'Photography of the Spectrum'; the volume on 'Poisons' in Wharton & Stillé's 'Medical Jurisprudence'; and 'Electrolysis and Its Applications to Treatment of Disease' (1886).

Amory, Thomas Coffin, lawyer and author: b. Boston 1812; d. there 1889. He graduated at Harvard 1830; and for many years was connected with the municipal government of Boston. Author of 'Life of James Sullivan' (2 vols. 1859); 'Military Services of Maj-Gen. John Sullivan' (1868); 'Life of Sir Isaac Coffin' (1886); 'The Siege of Newport: a Poem' (1888); 'Charles River: a Poem' (1888).

Amos, the prophet: the earliest identifiable Hebrew writer, and the first extant prophet who wrote his prophecies, therefore of great historical importance not only for Hebrew conditions in his age, but for the evolution of their religious thought. He lived under Jeroboam II. of Israel (790–749 B.C.) and Uzziah of Judah at least during part of his career; was in Israel perhaps between 765 and 750, though there are strong reasons for putting him after 745. He was probably a man of position, a fig-planter and cattle-owner (though he calls himself a fig-picker and herdsman) from Tekoa in Judah (see 2 Sam. xiv. 2 for the estimate of its people's astuteness in David's time), near Arabia and the Dedanites; his opportunities for meeting varied human elements had been good, his intellect was vigorous and his nature lofty, and his writings show a singular cultivation and refinement which reminds one how often the Eastern herdsman thus surprises the traveler. He felt that he had a burning moral message to deliver to the Hebrews, and the place to deliver it was in the far more important northern kingdom, then in the flower of its prosperity first and last. Assyria had been greatly weakened by the growth of the kingdom of Urartu (Armenia) to the north, and by internal revolts under Ashur-dan (772–755); meantime it had trampled Damascus into a temporary impotence for aggression. Jeroboam in his long reign was therefore able to win back all that Hazael had taken away, and extend his kingdom from Hamath in Syria down to the Dead Sea: he captured two places in Gilead, and his people thought their military prowess irresistible; they suffered from no raids or tribute, wealth and luxury were increasing rapidly, and self-indulgence with it. As always, laxer foreign religions had come in also: Yahwé was relied on as the national champion, but other gods were worshipped also, and even with him the connection was becoming non-moral, a costly ritual usurping the place of ethical religion. Into this comfortable and boastful population, expecting no attack from Assyria, and with their unhampering religion, came the great moral teacher from the other kingdom, preaching everything most alien and distasteful to them: that their military successes are nothing, and Yahwé will raise up a nation to carry them off beyond Damascus (transplantation, as a means of breaking up rebellious elements and unifying the empire, was introduced by Tiglath-pileser II. of Assyria, 745–727, which suggests the later date for Amos); that Yahwé hates their burnt-offerings and wants nothing but righteousness; that precisely because he is closer to them will he judge them more severely; and that while he will eventually not let the race of Jacob die, he will not restore it till the present kingdom has been obliterated from the earth. This was taking the heart out of the people; and when he came to Bethel, the northern Jerusalem, and reiterated his warnings that Jeroboam would die by the sword and the people be deported, Amaziah the high priest reported him to the king as a public nuisance and conspirator, and contemptuously told him to go back to Judah and prophesy to such as would pay him, but not to do it in Bethel, for it was the king's. This brought out the invaluable autobiographic fragment (vii. 14–15), wherein he tells us of his position, and that he is none of the guild of professional prophets and does not need to take fees for his utterances, but a private individual with a call from God to go out and tell the truth. For him, indeed, it is correct to say God and not Yahwé: he is an ethical

monotheist. His writings as they stand show signs of change and interpolation from subsequent hands; but the undoubtedly authentic part exhibits fine literary as well as intellectual and spiritual qualities, and the imagery is graphic and certifies to his pastoral and agricultural employment. (A special work on Amos is by H. G. Mitchell, Boston, 1889.)

Amphib'ia, a class of back-boned creeping animals comprising the newts, frogs, and toads, together with several extinct groups, which is classified between the fishes and the reptiles. The most prominent characteristic is indicated by the name, which refers to the fact that these animals are provided with a respiratory apparatus which enables them to breathe both water and air. It is not meant, however, that the *Amphibia* are able to breathe in either air or water at the same time, but that the young are provided with gills and live in water up to a certain age, or in rare cases permanently, after which they acquire lungs and thereafter breathe atmospheric air. As these young as a rule are different from their parents and must undergo metamorphosis from the larval into the adult condition, amphibians as a class are usually said to undergo metamorphosis, but this is equally true of some fishes and it is not true of all amphibians. The evidence not only of modern similarity of structure, but that obtained from a study of the fossil forms, makes it plain that the *Amphibia* are the result of the evolution of a branch from an ancient fish-stock, probably by way of the lung-fishes or *Dipnoi* (q.v.). On the other hand they are related in a not very different degree to the reptiles. The connection link according to Gadow, is formed by the *Stegocephali;* all the recent orders are far too specialized. The line leading from *Stegocephali* to fossil reptiles is extremely gradual, and the same consideration applies to the line which leads downward to the fishes; but the great gulf within the *Vertebrata* lies between fishes and amphibians, that is, between absolutely aquatic creatures with internal gills and fins, and terrestrial four-footed creatures with lungs and fingers and toes. No great phylogenetic importance attaches to the possession of external gills, as it is not unlikely that in the *Amphibia* these organs owe their origin to entirely larval requirements.

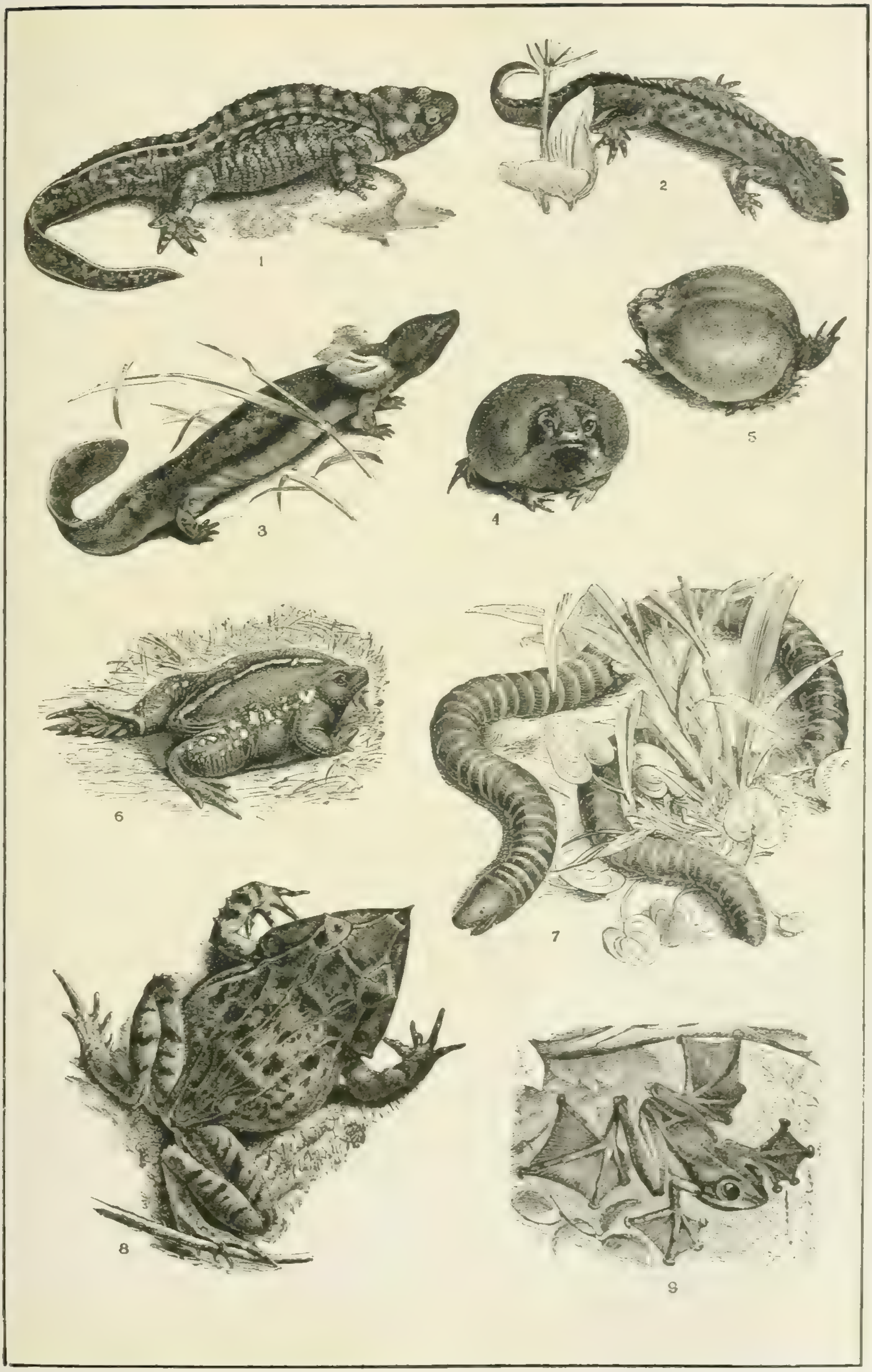
Although in the Palæozoic age the great stegocephalous amphibians (more usually called labyrinthodonts, q.v.), flourished as the only terrestrial vertebrates of importance, the class never attained a dominant position. Intermediate between the aquatic fishes and the gradually rising terrestrial reptiles, the amphibians were pushed aside in a double way by the struggle of evolution, until now most of them have become extinct. The remainder persist only because they have found shelter in the nooks and corners of the world to which they have become adapted by small size and aquatic habits; and only one group, the frogs and toads, fortunate in their plasticity, have spread over the whole globe and exhibit some richness in forms.

The class *Amphibia* is divided into two subclasses: (1) *Stegocephali* (q.v.), which is wholly extinct; (2) *Lissamphibia*, which includes all of the modern forms, contained in three orders: (1) *Apoda,* composed of the family *Cæcilliidæ* (see CÆCILLIANS); (2) *Urodela,* including the long-tailed, smooth-skinned, aquatic salamanders, newts, mud-puppies, and the like; (3) *Anura,* comprising the tailless forms, or frogs and toads, of which there are two divisions,— the few *Aglossa,* which have no tongue, and the tongue-bearing *Phaneroglossa,* which includes the great majority of forms.

Fossil Amphibia. The modern frogs and salamanders are a small and scanty remnant of the *Amphibia* of Palæzoic time. During the Carboniferous and Permian periods they were the dominant form of life and of great variety in form, including some of very large size, 12 feet or more in length. All these ancient *Amphibia* belong to an extinct group, the *Labyrinthodonta* (sometimes called *Stegocephalia*), or "armored amphibians," distinguished by having the wide flat head completely roofed over with bone, and the body more or less armored with bony plates and scales. The skull has two openings for the eyes, two at the front margin for the nostrils, and a single one in the middle for the pineal eye. Like modern amphibians, they breathed by gills when young, but by lungs when adult. All had long tails and most of them short stout legs. Some were elongated and snake-like, others tadpole-like with large heads shaped like a broad arrow (*Diplocaulus*) and no limbs; others, and these the largest, heavy-bodied, with flat conical or semi-circular heads, short legs, and five-toed feet (*Labyrinthodon, Eryops*).

These ancient amphibians illustrate various stages in the evolution of the backbone of modern *Vertebrata* from the notochord or segmented rod of cartilage from which it was derived. In the smaller and more primitive types the segments of cartilage are but slightly ossified in a number of separate plates or incomplete rings of bone. In others each vertebra is composed of two or four pieces, which remain separate during life instead of consolidating into a single bone, as in modern vertebrates. In others, again, the vertebra is completely united. The oldest known labyrinthodonts are from the Carboniferous rocks, and are related to some of the older Palæozoic dipnoan fishes, from which they may have been descended. In the Permian they attained large size and great abundance, and continued into the Triassic period, by the end of which they had become extinct. Their foot-tracks, often preserved in muddy sandstones of these periods, are sometimes curiously like the impressions of a human hand, whence they received the name of *Cheirotherium,* or "beast-with-a-hand," before their nature was recognized. The frogs and salamanders are probably descended from primitive labyrinthodonts, but are very little known as fossils. One fossil species, allied to the giant salamander of Japan, was found in the Miocene strata of Oeningen many years ago (1726) and was supposed by an early naturalist to be the fossil skeleton of a man, and described as "*homo diluvii testis et theoscopos*"— the man who was witness to the Deluge and saw God — a quaint reminder of the geological speculations of two centuries ago.

Consult Gadow, 'Amphibia and Reptiles' (London, 1901); Boulenger, 'Catalogue of Batrachia' in British Museum (London, 1882); and many papers in English scientific periodicals; Cope, 'Batrachia of North America.'



1. A Spanish Salamander (Pleurodires waltli).
2. European Crested Newt (Triton cristatus).
3. Menobranch (Necturus maculatus).
4-5. East African Toad (Breviceps mossambicus).
6. A Mexican Toad (Rhinophrynus dorsalis).
7. An Amphisbæna (Siphonops annulatus).
8. Horned Frog (Ceratobatrachus Guentheri).
9. Flying Frog (Rhacophorus pardalis).

Amphibole, am'fi-bōl (from the Greek *amphibolos,* "doubtful," in allusion to the difficulty of distinguishing it from pyroxene). In mineralogy, (1) a common mineral, crystallizing in the monoclinic system, and varying greatly in chemical composition. The name was first given by Haüy in 1801 as distinguishing a species of which he regarded hornblende and actinolite as varieties. In 1809 he included tremolite also. In general, the species may be described as a normal metasilicate of calcium and magnesium, associated with iron, manganese, sodium, potassium, and hydrogen.

(2) *Amphibole group.*— An important group of minerals, including the species described above, and taking its name therefrom. Its constituent species are widely different in chemical composition, and are closely allied to the members of the pyroxene group. All the species of the amphibole group have a prismatic cleavage of from 54° to 56°, and they also exhibit close relationships in the optical properties. All the species of the pyroxene group have a fundamental prism with an angle of 93° and 87°, the corresponding angle in amphibole being 56° and 124°. The specific gravity of the pyroxenes is usually higher than that of the species of the amphiboles with which they are likely to be confused. Alkalis are met with more commonly in the amphiboles, and magnesium is also more prominent in that group. The amphibole group is divided into three main sections according to the crystalline forms of its species. Dana's classification is as follows:

A. Orthorhombic Section.
- Anthophyllite.
- (Gedrite.)

B. Monoclinic Section.
- Amphibole:
  - *Non-aluminous varieties*:
    - Tremolite.
    - Actinolite.
    - Cummingtonite.
    - Dannemorite.
    - Grünerite.
    - Richterite.
  - *Aluminous varieties*:
    - Edenite.
    - Pargasite.
    - Hornblende.
- Glaucophane.
- Riebeckite.
- Crocidolite.
- Arfvedsonite.
- (Barkevikite.)

C. Triclinic Section.
- Ænigmatite.

Amphibol'ogy, an equivocal phrase or sentence, not from the double sense of any of the words, but from its admitting a double construction, as "The duke yet lives that Henry shall depose." The word *that* may be ambiguous, and consequently the sentence is an example of equivocation, not amphibology.

Amphic'tyon'ic League or **Council,** in ancient Greece, an assembly composed of deputies from 12 Greek tribes, each of which sent two deputies, who assembled with great solemnity; composed the public dissensions, and the quarrels of individual cities, by force or persuasion; punished civil and criminal offenses, and particularly transgressions of the law of nations and violations of the temple of Delphi. After the decision was published a fine was inflicted on the guilty state, which if not paid in due time was doubled. If the state did not then submit, the whole confederacy took arms to reduce it to obedience. The assembly had also the right of excluding it from the confederation. An instance of the exercise of this right gave rise to the Phocian war, which continued 10 years (B.C. 355–346).

Amphic'yon, a genus of extinct mammals, found fossil in Miocene rocks, which is usually placed among the extinct *Canidæ* (dogs), but has many bear-like features, such as plantigrade, five-toed feet, and the structure of the ulna and radius. The largest species was about the size of a bear, but with a very dog-like head. It belonged to the Old World, but a closely allied American Miocene form is *Daphænus.*

Am'phineu'ra. See Mollusks.

Amphi'on, in Greek mythology, son of Zeus and Antiope, his twin brother being Zethus. He is represented as being the oldest of the Grecian musicians. In Lydia, where he maried Niobe, the daughter of King Tantalus, he learned music, and brought it thence into Greece. He reigned in Thebes, which he partly built, and it is said that at the sound of his lyre the stones voluntarily formed themselves into walls; also that wild beasts, and even trees, rocks, and streams followed the musician. With the aid of his brother Zethus he is said to have avenged Antiope, who had been imprisoned and ill-used by his father, and to have bound Dirce, his stepmother, to the horns of a wild bull. This incident is supposed to be represented by the famous piece of sculpture, the Farnese bull, in the Farnese Palace at Rome.

Am'phiox'us, the lancelet, a small animal of the marine class *Leptocardii.* Its earliest scientific name is *Branchiostoma.* From its somewhat worm-like form it was for a long time regarded as a worm by some authors, and originally as a mollusk (*Limax*) by Pallas. It is now named *Amphioxus lanceolatus;* lives buried in the sand just below low-water mark, the head or "oral hood" projecting above into the water. It also swims in a vertical or upright position, also frequently lying on one side on the sand; and burrows head foremost rapidly downward in the sand. It extends along our coast from the mouth of Chesapeake Bay to Florida; also on the eastern coast of South America and in the north European seas, the Mediterranean, the East Indies and Australasia, the species being truly cosmopolitan. Another very closely allied genus, *Asymmetron,* includes two species, one of which occurs at the Bahamas, and the other in the Louisade Archipelago, southeast of New Guinea.

The body of *Amphioxus* is about two inches in length, slender, compressed, pointed at each end, hence the generic name (*Amphioxus, ἀμφί* both, *ὀξύς,* sharp), the head-end being thin and compressed. The muscular segments are distinct to the naked eye. From the mouth to the vent is a deep ventral furrow, and a slight dorsal fin extends along the back and beneath as far front as the vent, forming the ventral fin, while the wider portion at the tail is the caudal fin. The oral hood has a large median external opening, which is oral, surrounded with a circle of ciliated tentacles supported by semi-cartilaginous processes arising from a circumoral ring. At the bottom of this opening is the mouth which leads directly into a large

broad pharynx or "bronchial sac," protected at the entrance by a number of minute ciliated lobes. The walls of this sac are perforated by long ciliated slits, of which there are more than a hundred pairs, comparable with those of the bronchial sacs of ascidians and of *Balanoglossus*. The water which enters the mouth passes out through these slits, where it oxygenates the blood and enters the peribranchial cavity, thence passing out of the body through the abdominal pore (atriopore). The pharynx leads to the stomach with which is connected the liver or cœcum. There is a system of blood-vessels, but no heart. A contractile median vessel, the ventral aorta, beginning at the free end of the liver, and extending along the underside of the pharynx, sends branches to the sac and two anterior branches to the dorsal aorta. On the dorsal side of the pharynx the blood is poured by the two anterior trunks, and by the branchial veins which carry away the aërated blood from the branchial bars, into a great longitudinal trunk or median dorsal aorta, by which it is distributed throughout the body. There are also vessels distributed to the liver, and returning vessels, representing the portal and hepatic veins. The blood-corpuscles are white and nucleated.

The vertebral column of the true vertebrates is represented in the lancelet by a notochord, a long, flexible, cylindrical rod pointed at both ends, which extends to the end of the head far in front of the nervous cord; and also by a series of semi-cartilaginous bodies above the nervous system, and which are thought to represent either neural spines or fin-rays. The nervous cord is a rod-like structure which lies over the notochord. It is not divided into a true brain and spinal cord, though the cord is slightly enlarged at the anterior end, where a rudimentary ventricle is said to exist. The nerve-cord sends off a few nerves to the periphery, with a nerve to the single minute median eye. An olfactory pit opens externally on the left side of the snout. The principal excretory organs are about ninety pairs of peculiarly modified nephridia, situated above the pharynx, and in relation with the main cœlomic cavities. The reproductive glands are square masses or pouches, of which there are about 26 pairs attached in a row on each of the walls of the body-cavity. The individuals may be male or female, the only sexual differences being in the reproductive glands.

The eggs may pass out of the mouth or through the pore. Kowalevsky found them issuing in May from the mouth of the female, and fertilized by spermatic particles, likewise issuing from the mouth of the male. The eggs are very small, 0.105 millimetres in diameter. The eggs undergo total segmentation, leaving a segmentation cavity. The body-cavity is next formed by invagination. The blastoderm now invaginates and the embyro swims about as a ciliated gastrula. The body is oval, and the germ does not differ much in appearance from a worm, starfish, or ascidian in the same stage of growth. No vertebrate features are developed. Soon the lively, ciliated gastrula elongates, the alimentary tube arises from the primitive gastrula cavity, while the edges of the flattened side of the body grow up as ridges, which afterward, as in all vertebrate embryos, grow over and enclose the spinal cord. When the germ is 24 hours old it assumes the form of a ciliated flattened cylinder, and now resembles an ascidian embryo, there being a nerve cavity with an external opening, which afterward closes. The notochord appears at this time. In the next stage observed the adult characters have appeared, the mouth is formed, the first pair of gill-openings are seen, 11 additional pairs appearing. It thus appears that while the lancelet at one time in its life presents ascidian features, yet, as Balfour states, "all the modes of development found in the higher vertebrates are to be looked upon as modifications of that of Amphioxus."

A. S. PACKARD,
Late Prof. Zoology, Brown University.

Amphip'oda, an order of Crustacea, in which the body is compressed and usually arched. There is no carapace or distinct cephalothorax, but a small head, bearing two pairs of antennæ, a pair of jaws (mandibles), and three pairs of maxillæ. The thoracic segments are separate and like those of the abdomen, not being fused and united with the head segments. Respiration is performed by lamellate or leaf-like gills arising from the middle pair of legs. The amphipods are represented by the common beach-flea or beach- or sand-hopper (*Orchestia agilis*); by Gammarus, or "scud," species of which live both in the sea and in fresh-water. Extreme forms are the ghost-like or skeleton-like attenuated *Caprella*, abounding in eel-grass below low tide; and which in walking loop the body somewhat like a geometricid caterpillar. Another form is *Chelura terebrans*, which burrows in wood, in company with the gribble. It is very active and frequently destructive to submerged piles. Other forms are eyeless and live in caves or dark wells.

Amphipolis, an important city of Thrace or Macedonia; at the mouth of the Strymon River, 33 miles from the Ægean. It was founded by an Athenian colony about 436 B.C.; was captured by Sparta in 424 B.C.; and near it the Spartans defeated the Athenians in 422 B.C. Subsequently it became a Macedonian possession; was called Popolia in the Middle Ages; and its site is now occupied by the Turkish town of Yenikeui.

Am'phisbæ'na, one of the degraded worm-shaped lizards of the family *Amphisbœnidœ*, which lead an entirely subterranean life, burrowing like earth-worms. They have a soft skin forming numerous rings and containing only vestiges of scales except upon the head. External limbs are absent (except in one genus), but only vestiges remain of any limb-bones. Their tails are so short and blunt that they are popularly said in some countries to have two heads, whence the scientific name of the group. This notion is strengthened by their ability to move either forward or backward with equal ease. About a dozen genera and more than 60 species are known, most of which inhabit the warmer parts of America and Africa; some also live in Asia Minor and in Spain. They are frequently found in ants' nests, and have been called "mothers of ants" in consequence. Their eyes and ears are concealed beneath the skin. A common species in South America and the West Indies (*Amphisbœna fuliginosa*) is checkered black and white, and is from one to two feet in length. Like the others it feeds

upon worms and small insects found under the surface of the ground. They are quite harmless.

Am'phithe'atre, with the Romans, a building without a roof, of a round or oval form, destined for the combats of gladiators or of wild beasts. In the middle was the arena, a large place covered with sand, on which the fights were exhibited. Round about were the vaults or caves in which the animals were kept; above these was the gallery, from which ascended successive rows of seats, each of greater height and circumference than the preceding. The first 14 were for the senators and judges, the others for the common people. Julius Cæsar erected the first large amphitheatre at Rome for his gladiatorial exhibitions. It was of wood. Statilius Taurus, 20 years later, built the first stone one. The Coliseum at Rome is the largest of all the ancient amphitheatres. (See COLISEUM.) In Verona there is one the interior of which still shows the whole ancient architecture and is carefully preserved.

Am'phitri'te, in Greek mythology, a daughter of Oceanus and Tethys, or of Nereus and Doris. Poseidon wished to make her his wife, and as she hid herself from him he sent a dolphin to find her, which brought her to him, and received as a reward a place among the stars. As a goddess and queen of the sea she is represented as drawn in a chariot of shells by tritons, or riding on a dolphin, before which a cupid swims, with the trident of Poseidon in her hand.

Amphit'ryon, in Greek mythology, king of Thebes, son of Alcæus, and husband of Alcmena. Plautus, and after him Molière, have made the trick played upon him by Zeus (in assuming his form in order to enjoy the embraces of his wife) the subject of amusing comedies, in which the return of the true Amphitryon, and his meeting with the false one, occasion several humorous scenes.

Am'phiu'ma, a genus of Amphibians that lose their tadpole gills, but retain a gill slit. See KONGO SNAKE.

Am'phora, a vessel used by the Greeks and Romans for holding various liquids, particularly wine. They were of various forms, but most commonly tall and narrow, with a pointed end which fitted into a hole or socket to enable them to stand upright. Properly an amphora was a two-handled vessel, from Greek *amphi*, both, and *phero*, to carry.

Amphoteric, a chemical property of many organic substances, urine, milk, blood, etc., to show acid to blue litmus and alkaline to red litmus, thus paradoxically being both acid and alkaline.

Am'plitude, in astronomy, the distance of any celestial body or other object (when referred by a secondary circle to the horizon) from the east or west points; the complement to the amplitude, or the distance from the north or south point, is called the azimuth.

Ampudia, Pedro de, Mexican soldier. He first appears in the wars against Texas, Santa Anna (q.v.) making him a general in 1840. He engaged in forays and fights here for some years, coming into conflict with Summerville's Texas troops and commanding the land forces in the siege of Campeachy; compelled to retreat 26 June 1843, he went to Tabasco, and in 1844 captured and summarily executed Sentmanat who had assaulted it. The act was loudly condemned, and he was dismissed. He reappeared in the United States-Mexican war under Arista; was in the fight at Matamoras, 11 April 1846; was given command of Monterey, but surrendered to Taylor 24 September and vanishes from history.

Ampul'la (Lat.), in antiquity, a vessel bellying out like a jug, that contained unguents for the bath; also a vessel for drinking at table. The ampulla has also been employed for ceremonial purposes, such as holding the oil or chrism used in various church rites and for anointing monarchs at their coronation.

Ampullaria. See APPLE-SHELL.

Am'puta'tion. See SURGERY.

Amraphel, king of Shinar (= Sumer, the Sumerian or South Babylonian plain), a monarch mentioned in Gen. xiv. as an ally of Chedorlaomer, king of Elam, in subduing his revolted Palestinian vassals. Two other allied kings are named: Arioch of Ellasar (Larsa, South Babylonia) and Tidal of Goiim (translated "nations" in Authorized Version; identified by some with Gutium in Media, by others with "the tribes" = the wandering Kurds). Neither of the names nor any mention of the raid is found on the inscriptions; and the expedition, with its capture of Lot and the successful recapture by Abraham, has no critical standing. Nevertheless it is most interesting historically; for the non-Jewish names are apparently genuine, and the conditions are precisely those of the times which the names would imply. Arioch would correspond to the Babylonian Eriaku, supposed to be found in a fragmentary epic on the invasion of Babylonia; Tid'al to a Tudhkula or Tudhghula also said to be recognizable there; and Chedorlaomer to Kudur-Laghamar, the first half of which is found in other Elamite royal names, as Kudur-Mabuk, etc., and the last is probable. As to Amraphel, he is very plausibly Hammurabi (q.v.), the great revivor of the Babylonian monarchy about 2250, after its conquest by the Elamites; or rather Hammurabi-ilu (the divine name el or ilu added, as common in Babylonian and Egyptian: cf. Joseph-el and Jacob-el against the Hebrew Joseph and Jacob), or perhaps Hammu-rapaltu, a probably dialectic variant of Kimta-rapashtu actually found written. Chedorlaomer's expedition is like other known ones of Babylonian kings against the lands west to the Mediterranean, which they claimed as tributary. But there is a closer verisimilitude, which makes it practically certain that the substance of the story was taken from a Babylonian tablet describing an actual occurrence: Amraphel in the story is a subordinate ally of Chedorlaomer, and the historical Hammurabi was apparently a dependent sub-king of Babylon under the Elamites before he threw off their yoke. The added Abraham story may represent a tradition welded with the other in later times.

Amritsir, ŭm-rĭt'săr, or **Umritsir** (that is, "the pool of immortality"), a town of Hindustan, capital of a district of the same name, in

the Panjab, the principal place of the religious worship of the Sikhs. It is, on account of its favorable situation between Cabul and Delhi, Cashmere, and the Deccan, a place of great trade, and has considerable manufactures of shawls and silks; but its chief attraction to the natives is the sacred pond constructed by Ram Das (one of the earlier pontiffs of the Sikh faith), in which the Sikhs immerse themselves that they may be purified from all sin. This holy basin is 150 paces square, built of brick, having in its centre the chief temple of the Sikh religion. Under a silken canopy in this temple is deposited the book of Sikh religion and laws, called the Granth. The voluntary contributions of pilgrims and devotees support this place, to which 600 priests are attached. Pop. (1901) 164,000 (including cantonments).

The district of Amritsir lies between the rivers Ravi and Bias. It is intersected by numerous canals. Its area is 1,601 miles. Pop. (1902) 2,500,000.

Am'ru, originally an opponent, and subsequently a zealous supporter of Mohammed, and one of the ablest of the Mohammedan warriors. He brought Egypt under the power of the Caliph Omar in 638, and governed it wisely till his death in 663. The burning of the famous Alexandrian Library has been generally attributed to him, though only on the authority of a writer who lived six centuries later.

Amsdorf, Nicolaus, a Protestant reformer of the 16th century: b. in Gross-Zschopa, near Wurzen, on the Mulde, 3 Dec. 1483; d. 14 May 1565. He was educated at Leipsic, and then at Wittenberg, where he was one of the first who matriculated (1502) in the recently-founded university. He obtained various academical honors, and became professor of theology in 1511. He joined Luther at the very beginning of his struggle (1517); continued all along one of his most determined supporters; was with him at the Leipsic Conference and the Diet of Worms; and was in the secret of his Wartburg seclusion. He assisted the first efforts of the Reformation at Magdeburg, at Goslar, and at Einbeck; took an active part in the debates at Schmalkald, where he defended the use of the sacrament by the unbelieving; and spoke out strongly against the bigamy of the Elector of Hesse. He urged the separation of the High Lutheran party from Melancthon, got the Saxon dukes to oppose the Frankfurt Recess (1558), and continued to fight for the purity of Lutheran doctrine until his death.

Amsler, Samuel, one of the most distinguished of engravers: b. in Schinznach, in the canton of Aargau, 1791; d. 18 May 1849. Amsler's principal engravings are 'The Triumphal March of Alexander the Great' and a full-length 'Christ,' after the sculptures of Thorwaldsen and Dannecker; the 'Burial of Christ,' and two 'Madonnas,' after the pictures of Raphael; and the 'Triumph of Religion in the Arts,' after Overbeck, his last work, on which he spent six years.

Amsterdam, formerly called **Amstelredam**, the capital of the Netherlands, is situated in the province of North Holland, at the influx of the Amstel to the Ij or Y (pronounced eye), an arm of the Zuyder Zee. The city is built in the shape of a semi-circle, and within this semicircle four canals — the Prinsen Gracht, Keizer's Gracht, Heeren Gracht, and the Singel — extend in the form of polygonal crescents, nearly parallel to each other, while numerous smaller canals intersect the city in every direction, dividing it into about 90 islands, with about 300 bridges. The site of Amsterdam was originally a peat bog, and all its buildings rest upon piles that are driven some 40 or 50 feet through a mass of loose sand and mud until they reach a solid stratum of firm clay. This foundation is perfectly secure as long as the piles remain under water. At the beginning of the 13th century it was merely a fishing village, with a small castle, the residence of the lords of Amstel. In 1296, on account of its share in the murder of Count Floris of Holland, the rising town was demolished; but in 1311, with Amstelland (the district on the banks of the Amstel), it was taken under the protection of the Counts of Holland, and from them received several privileges which contributed to its subsequent prosperity. In 1482 it was walled and fortified. After the revolt of the seven provinces (1566) it speedily rose to be their first commercial city and a great asylum for the Flemish Protestants; and in 1585 it was considerably enlarged by the building of the new town on the west. The establishment of the Dutch East India Company (1602) did much to forward the well-being of Amsterdam, which, 20 years later, had 100,000 inhabitants. In the middle of that century the war with England so far reduced the commerce of the port that, in 1653, 4,000 houses stood uninhabited. Amsterdam had to surrender to the Prussians in 1787, to the French in 1795; and the union of Holland with France in 1810 entirely destroyed its foreign trade, while the excise and other new regulations impoverished its inland resources. The old firms, however, lived through the time of difficulty, and in 1815 commerce again began to expand — an expansion greatly promoted by the opening in 1876 of a new and more direct waterway between the North Sea and the city.

The city has a fine appearance when seen from the harbor or from the high bridge over the Amstel. Church towers and spires, and a perfect forest of masts, relieve the flatness of the prospect. The old ramparts have been leveled, planted with trees, and formed into promenades. Between 1866 and 1876 many spacious streets and an extensive public park were added to the city. Tramways have been successfully introduced, and the harbor greatly improved. There is railway communication with all parts of the country and of Europe. Rich grassy meadows surround the city. On the west side are a great number of windmills for grinding corn and sawing wood. On each side of the three chief canals, with a row of trees and a carriage-way intervening, are handsome residences. The building material is brick; and the houses have their gables toward the streets, which gives them a picturesque appearance. The defenses of Amsterdam now consist in a row of detached forts, and in the sluices, several miles distant from the city, which can flood in a few hours the surrounding land. A hard frost, however, like that of 1794–5, when Pichegru invaded the country, would render this means of defense useless.

The population, which from 217,024 in 1704, sank to 180,179 in 1815, rose steadily to 503,285 in 1897, of whom the majority belong to the

Dutch Reformed Church. Of the remainder, about 80,000 were Catholics, 30,000 German Jews, and 3,200 Portuguese Jews. The chief industrial establishments are sugar refineries, engineering works, mills for polishing diamonds and other precious stones, dockyards, manufactories of sails, ropes, tobacco, silks, gold and silver plate and jewelry, colors, and chemicals, breweries, distilleries, with export houses for corn and colonial produce; cotton-spinning, book-printing, and type-founding are also carried on. The present Bank of the Netherlands dates from 1824, Amsterdam's famous bank of 1609 having been dissolved in 1796.

The former Stadhuis ("townhouse"), converted in 1808 into a palace for King Louis Bonaparte, and still retained by the reigning family, is a noble structure. Built by Van Kampen in 1648–55, and raised upon 13,659 piles, it extends 282 feet in length by 235 feet in breadth, and is surmounted by a round tower rising 182 feet from the base. It has a hall 120 feet long, 57 wide, and 90 high, lined with white Italian marble — an apartment of great splendor. The cruciform *Nieuwe Kerk* (New Church), a Gothic edifice of 1408–14, is the finest ecclesiastical structure in the city, with a splendidly carved pulpit, and the tombs of Admiral de Ruyter, the great Dutch poet Vondel, and various other worthies. The Old Church (*Oude Kerk*), built in the 14th century, is rich in painted glass, has a grand organ, and contains several monuments of naval heroes. Literature and science are represented by a university supported by the municipality (till 1876 known as the *Athenæum Illustre*), by academies of arts and sciences, by museums and picture galleries, a palace of national industry, a botanical garden, several theatres, etc. The new Ryksmuseum contains a truly national collection of paintings, its choicest treasure being Rembrandt's 'Night-guard.' Rembrandt (q.v.) made Amsterdam his home; and his statue (1852) now fronts the house he occupied. Spinoza was a native. The hospital for aged people, the poorhouse, house of correction, the orphan asylums, a navigation school, and many benevolent societies, are well supported and managed on good principles. A water supply was introduced in 1853. The North Holland Canal, to which Amsterdam is so largely indebted for the rapid increase of its commerce, is noticed under Zuider Zee. Pop. (1891) 417,539.

Amsterdam, N. Y., a city of Montgomery County, 33 miles northwest of Albany. It is located on the Mohawk River, the Erie Canal, and the West Shore railway, and is a busy manufacturing centre.

Industries, etc.— Amsterdam has about half a hundred factories, among the numerous products being such diversified objects as carpets, knit-goods, rugs, wagon-springs, paper, silk, paper-boxes, and brooms. There are also foundries and machine-shops; three daily newspapers are published.

Public Institutions, Buildings, etc.— Here are located an academy, a hospital, a board of trade, numerous churches, and a Roman Catholic institute. There are well-paved streets, a fine system of drainage, an excellent water supply, and an electric lighting system.

History.— Amsterdam was first settled about 1778, and until 1804 it was known as Veedersburg. It was incorporated as a village in 1830, and as a city in 1885. Pop. (1890) 17,336; (1900) 20,929; (1905) 23,943.

Amu, Amoo, Amoo Darya (Arab. *Gihon*), a river of Central Asia, the ancient Oxus. It takes its rise in the eastern Pamir, near the boundary of eastern Turkestan, flows at first generally west (to lon. 66° E.), thence generally northwest, and empties by a delta into the southern part of the Aral Sea. It receives several affluents from the mountains of Turkestan and the Hindoo Koosh. About 1,600 miles in length, it is navigable by light draught vessels for about 800. As a means of irrigation, it is of considerable importance.

Amulet, a piece of stone, metal, or other substance, marked with certain figures or characters, which people wear about them as a protection against diseases and enchantments. The name, as well as the thing itself, is derived from the East. The word comes from the Arabic *hamalah* (anything hung round the neck). Among the Turks, and many people of central Asia, every individual thinks an amulet necessary to secure him from harm. They were introduced into Christian Europe by the Jews. With the ancients, for example, the Egyptians, Greeks, Romans, they were frequently found. From the pagans they were introduced among the Basilidians. Their amulets were stones with the word *Abraxas* engraved on them. The Jews had many superstitious notions about amulets. Many Christians of the 1st century wore amulets which were marked with a fish as a symbol of the Redeemer. To the Christian divines the use of amulets was interdicted by the Council of Laodicea under penalty of dismissal from office. With the spread of Arabian science and astrology the astrological amulets of the Arabians, the talismans, came into use in the West. The Turks, the Chinese, the people of Thibet, and many other nations, have yet great confidence in them. See Superstition; Talisman.

Amur, am-ör', a river formed by the junction (about lat. 53° N. and lon. 121° E.) of the Shilka and the Argun, which both come from the southwest. From the junction the river flows first southeast and then northeast, and, after a total course of 3,060 miles, falls into the Sea of Okhotsk opposite the island of Sakhalin. It is very valuable for navigation, and carries a considerable fleet of steamers, but on account of the bar at its mouth goods are generally disembarked and carried overland to Alexandrovsk.

In 1636 Russian adventurers made excursions to the lower Amur, and in 1666 built stations and a fort at Albazin. In 1685 both stations and the fort were taken by the Chinese, but were promptly retaken by the Russians, who in 1689 abandoned the whole territory of the Amur to the Chinese.

In 1854–6 two military expeditions were conducted by Count Muravieff, who established the stations of Alexandrovsk and Nikolaevsk. In 1858 China agreed to the Treaty of Tientsin, by which the boundaries of Russia and China were defined. The left bank of the Amur and all the territory north of it became Russian; and below the confluence of the Ussuri both banks. In 1860, after the occupation of

Pekin by the British and French, General Ignatieff secured the signature of Prince Kung to a treaty by which Russia acquired the broad and wide territory comprised between the river Amur and the mouth of the Tumên, extending 10° of latitude nearer the temperate regions, and running from the shore of the north Pacific eastward to the banks of the river Ussuri, a principal affluent of the Amur. In September 1900 Russia took formal possession of the right bank of the river.

This vast territory falls into two Russian provinces — the Maritime Province between the Ussuri and the sea, and the government of Amur north of the river. The latter has an area of 175,000 square miles. The country is richly timbered, and is admirably adapted for pasturage and agriculture, though the climate is severe. Fur-bearing animals are still plentiful, and the river abounds in fish. The capital is Khabarovka. Nikolaevsk, once the only important place in these regions, is on the Amur, 26 miles from its mouth, where the river is 1¼ miles wide, and in places 15 feet deep; but the political centre tends southward to the more temperate Maritime Province (area, 730,000 square miles), near the southern end of which is situated the important harbor of Vladivostok ("Rule of the East"), or Port May, which in 1872 was placed in telegraphic communication with Europe by the China submarine cable, and is now the capital of the Amur provinces. The island of Sakhalin (Saghalien), north of the Japan group, along a portion of the coast of Asiatic Russia, and formerly possessed partly by Russia and partly by Japan, is also a part of the Amur region in the wider sense.

Amurath I., ä'mōō-rät, a sultan of the Turks; succeeded his father Orchan in 1360. He founded the corps of Janissaries, conquered Phrygia, and on the plains of Cassova defeated the Christians. In this battle he was wounded, and died the next day, 1389.

Amurath II., one of the more illustrious of the Ottoman emperors, succeeded his father, Mohammed I., in 1421, at the age of 17. In 1423 he took Thessalonica from the Venetians; in 1435 subdued the despot of Servia, besieged Belgrade, which was successfully defended by John Hunniades; defeated the Hungarians at Varna in 1444, and slew their king, Ladislaus. He died in 1451.

Amurath III., succeeded his father, Selim II., in 1574. His first act was the murder of his five brothers. He added several of the best provinces of Persia to the Turkish empire. He was noted for his avarice, and his sensual excesses made him prematurely old. He died in 1595.

Amurath IV., succeeded his uncle, Mustapha X., 1623. After two unsuccessful attempts he took Bagdad from the Persians in 1638, and ordered the massacre of 30,000 prisoners who had surrendered at discretion. The excessive cruelty and debauchery of Amurath IV. have earned for him the character of being one of the worst sovereigns that ever reigned over the Ottomans. He died in 1640.

Amurath V., Sultan of Turkey: b. 21 Sept. 1840, and succeeded to the throne in 1876 as the result of a revolution that caused the overthrow of his uncle Abdul Aziz His reign was for a few months only, as he developed strong symptoms of insanity and was deposed in August 1876.

Amyclæ. (1) An ancient town of Laconia, on the eastern bank of the Eurotas, 2½ miles southeast of Sparta. It was the home of Castor and Pollux, the "Amyclæan brothers." It was conquered by the Spartans only before the first Messenian war. (2) An ancient town of Latium, which claimed to have been built by a colony from the Greek Amyclæ.

Amygdalin, a-mig'da-lin (from the Latin *amygdala,* "almond"), a crystalline substance occurring in bitter almonds, in the kernels of apples, pears, and peaches, in the leaves of the laurel (*Cerasus lauro-cerasus*), and in the leaves and bark of various species of the genus *Prunus.* It has the formula $C_{20}H_{27}NO_{11}+3H_2O$, and is of special interest to the chemist because it was the first known of the numerous class of substances termed "glucosides" (q.v.). It is obtained by extraction, with boiling alcohol, of the pulp left after the expression of the oil from bitter almonds. The alcoholic solution is concentrated by evaporation, and the amygdalin precipitated by the addition of ether, in which it is insoluble. Like the other glucosides, amygdalin does not form salts with acids, but is decomposed by them with the formation of glucose.

Amyg'daloid, in geology, an igneous rock containing numerous almond-shaped or spherical enclosures of material distinctly different, either chemically or physically, from that which constitutes the rock itself. The enclosures were originally cavities due to the inclusion of steam or gases. Lava frequently exhibits a structure of this kind, its enclosures being commonly calcite or quartz.

Am'yl (from the Latin *amylum,* "starch," its first-known compounds being obtained by the distillation of fermented starchy matter), an important organic radical having the formula C_5H_{11}, and belonging in the fatty series. It is also called "pentyl," because, in the long list of analogous radicals having the general formula C_nH_{2n+1} amyl is the particular radical in which $n=5$. Amyl cannot exist in the free state, but two of its molecules can combine to form the paraffin "decane," $C_{10}H_{22}$, which is a liquid boiling at about 320° F. The radical amyl can have no less than eight different isomeric forms, and the chemistry of its compounds is correspondingly complicated. Of the many compounds that are known, however, only three are especially important in the arts. These are: (1) amyl alcohol, (2) amyl acetate, and (3) amyl nitrite.

(1) Eight isomeric amyl alcohols are theoretically possible, one for each of the theoretically possible isomeric forms of the radical itself; and seven of these are actually known. Five of the seven are of no particular importance in practical chemistry, but the remaining two, known respectively as the "active" and "inactive" amyl alcohols, constitute the greater part of the fusel-oil (q.v.) that is obtained abundantly in the manufacture of potato brandy, and less abundantly in the preparation of many other kinds of distilled liquors. "Active" amyl alcohol has the formula $CH_3.CH.C_2H_5.CH_2.OH$, boils at about 262° F., and takes its name from

the fact that it rotates the plane of polarized light to the left. «Inactive» amyl alcohol has the formula $(CH_3)_2.CH.CH_2.CH_2.OH$, boils at about 269° F., solidifies at —4° F., and has no effect upon polarized light. These two kinds of amyl alcohol may be obtained, mixed, by washing fusel-oil with water, and subsequent rectification. They may then be separated by fractional distillation, or by other more exact methods, for which see special treatises.

(2) Amyl acetate (more exactly, «iso-amyl acetate,» since six acetates are known), is prepared by distilling a mixture of the foregoing amyl alcohols with sodium acetate and sulphuric acid. It is a liquid, boiling at about 282° F., and possessing a strong fruit-like smell. It is used for flavoring cheap confectionery.

(3) Amyl nitrite, $C_5H_{11}.NO_2$, may be formed by distilling a mixture of the foregoing amyl alcohols with potassium nitrite and dilute sulphuric acid. It is a yellow liquid, with an ethereal, fruity odor. When its vapor is inhaled, it paralyzes the vaso-motor nervous system and lowers the blood pressure. Amyl nitrite is often administered in this way for the cure of obstinate hiccoughing. Its effects are powerful and almost instantaneous, and it should never be tried except under the guidance of a physician.

Amylene Hydrate, an alcohol used as a hypnotic. It is technically a tertiary iso-amyl alcohol $[(CH_3)_2C(OH)CH_2CH_3]$, and is a limpid, colorless, neutral fluid with a peculiar odor and a burning taste. It is miscible with eight parts of water and freely miscible with alcohol, chloroform, and fixed oils. It has an action on the human body similar to that of other alcohols, and is a useful hypnotic, occupying a position between chloral, which is twice as strong, and paraldehyde, which has about half the strength of amylene hydrate. In large doses it is a heart depressant.

Amylop'sin, a chemical (or unorganized) ferment, occurring in the pancreatic fluid, together with steapsin and trypsin. The chief function of amylopsin, in intestinal digestion, is to effect the conversion of starches and similar substances (amyloses) into sugars (dextrins, maltoses, isomaltoses, and glucose). The conversion takes place in the small intestine. Amylopsin is often called the «pancreatic diastase.» See PANCREAS.

Am'ylose, any carbohydrate (q.v.) which can be classified as starch, dextrin, cellulose, or natural gum. The remaining members of the carbohydrate group are classed as glucoses or saccharoses. The general formula of an amylose is $(C_6H_{10}O_5)$ n. See CARBOHYDRATE; CELLULOSE; DEXTRIN; STARCH; GUM.

Amyntas, the name of various characters in ancient Greek or Macedonian history, especially kings of Macedonia. (1) A son of Alcetas, reigned about 540 to 500 B.C., and he was succeeded by his son, Alexander I. (2) King of Macedonia, son of Philip, and brother of Perdiccas II.; reigned 393 to 369 B.C., having gained the crown by the murder of Pausanias. He was engaged in war with the Olynthians and assisted by the Spartans. He was father of Alexander, Perdiccas, and the famous Philip. (3) Philip excluded the grandson of Amyntas II. from his succession and he was put to death in the first year of the reign of Alexander the Great because of a plot against the life of Alexander. The 4th was a Macedonian officer in Alexander's army.

Amyntor, Gerhard von, pseudonym of Dagobert von Gerhardt, a German novelist and poet: b. Liegnitz, Silesia, 12 July 1831. He entered the army in 1849, took part in the campaigns of 1864 and 1870–1 as a major, was severely wounded in the former and resigned in 1872; settled in Potsdam in 1874. His principal works are 'Peter Quidam's Rhine-Journey' (1877), an epic; 'Songs of a German Night Watchman' (1878); 'The New Romancero' (1880), poems; 'The Priest' (1881), an epic; novels, 'It Is You' (1882); 'A Problem' (1884); 'Praise of Woman' (1885); and 'Gerke Suteminne' (1887), a historical romance.

Amyot, Jacques, ä-mē-ō', a French author: b. 30 Oct. 1513; d. 6 Feb. 1593. He is famous for his translations from the Greek, which, owing to their elegant style, are considered classical literature. They are the 'Theagenes and Chariclea' of Heliodorus; 'Seven Books of Diodorus Siculus,' the 'Daphnis and Chloe' of Longus; and 'Plutarch's Lives,' which was used by Corneille as a source for his antique tragedies, and by Shakespeare (in its English version by Sir Thomas North) for some of his plays.

Amyraut, Moïse, a French Calvinist theologian: b. in Bourgueil, in the province of Anjou, 1596; d. 1664. He was educated at Saumur, where he was himself afterward a professor of divinity. By his talents and moderation he soon acquired reputation and influence. In 1631 he attended the Synod of Clarendon, and was commissioned to present to the king the remonstrances of his brethren against the infraction of the edicts of pacification. In his mission he acted with such judgment and dignity that he succeeded in relieving the Protestant deputies from the disgraceful obligation of addressing the king on their knees. Although he was a Protestant, his amiable temper and courteous manners commanded the regard of the Catholics, and he was held in particular esteem by Cardinal Richelieu. He endeavored to bring about a complete union between the various Protestant Churches; this object he had in view in nearly all his writings, especially in a Latin tract, '*De secessione ab ecclesia Romana, deque pace inter Evangelicos in negotio religionis instituenda.*' Moreover, acting in concert with Richelieu, he aimed at a reconciliation between the Protestants and the Roman Catholic Church. The favor and respect with which he was treated by the heads of the French government, Richelieu, and Mazarin, are to be ascribed to his opinions concerning the power of the princes. He publicly maintained on several occasions the doctrine of implicit obedience to the sovereign authority, which, indeed, had also been held by the great founders of the Reformation. Amyraut was a finished scholar, and wrote Latin and French with equal ease. His numerous writings, which were received with marked favor in his time, are now nearly forgotten and not easy to be procured. Among the number we may mention 'A Treatise on Religions, Against Those Who Esteem Them to Be Indifferent'; 'Christian Morals'; 'A Treatise on Dreams'; 'Against the Millenarists'; 'Considerations on the Laws of Nature Regulating Marriage.'

Amyridaceæ, a natural order of tropical plants, consisting of trees or shrubs with opposite or alternate compound leaves, frequently stipulate and dotted; the flowers are usually bisexual, but are sometimes unisexual by abortion. They yield resinous and balsamic juices, which are sometimes used medicinally, and receive such names as bdellium, elemi, frankincense, myrrh, olibanum, tacamahac. (See these articles.) Among the chief genera of the order are *Amyris, Balsamodendron, Boswellia, Canarium,* and *Icica.* They are sometimes classed as a suborder of *Anacardiaceæ.*

An, or ON, the Egyptian name of the city of Heliopolis.

Ana, a comparatively modern designation applied to collections of the sayings and observations of eminent persons, as well as to gossip or criticism pertaining to them.

Anabaptists (Greek, ἀνά, again, βαπτίζειν, to baptize), those who baptize again persons admitted to their communion, when such converts have been baptized in their infancy or have been merely sprinkled and not immersed in baptism or have been baptized in any way without being capable of declaring the doctrines which they believe and giving a reason for the hope that is in them. Baptists (q.v.) of the present day are not properly to be styled Anabaptists, as they lay no capital emphasis upon the necessity for rebaptism, although they have very definite canons on the subject of immersion.

Anabaptists of the early Church.— In the 3d century of the Christian era, the century which witnessed such violent and bitter controversies, the question of baptism came also under discussion. In the Eastern Church, including Asia Minor, Egypt, North Eastern Africa and Constantinople, it was definitely maintained that baptism was invalid unless it was administered by one of the clergy with proper matter and form. In the Western Church, including Italy, Gaul, Spain, and North Western Africa, it was held that the virtue of baptism lay in the invocation of the Trinity, and the ceremonial sprinkling with, or immersion in the water. Any baptism thus administered by a person of either sex, by a clergyman or a layman, was equally valid. When two children in their play mimicked the act of a priest whom they had seen baptizing an infant, Saint Augustine of Hippo declared that the boy who had been thus baptized by his companion was a real and actual partaker of the benefits and bound by all the vows pertaining to this sacrament. The controversy between the East and the West continued, however, to rage with such fury that two councils were called to settle the question. The one was held in Iconium, Asia Minor, in 235, the other at Synnada in 256. At these theological synods the decision arrived at was, that rebaptism was unnecessary for those who had been baptized by heretics. The storm of controversy swept westward to Northern Africa as far as Carthage, where Tertullian supported the position of the Eastern Church in contrariety to that of Saint Augustine and other Western doctors. Agrippinus, bishop of Carthage, maintained against the bishop of Rome that baptism under certain circumstances ought to be repeated. His followers were called Agrippinians and his defiance of the bishop of Rome took the form of a concilier decree which was issued by a synod which he convened and which endorsed the sentence of Iconium. In the year 253 Stephen, bishop of Rome, fulminated a bull of excommunication against all the bishops of Asia Minor, including Cappadocia, Galatia and Phrygia, whom he styled Rebaptizers and Anabaptists in an opprobrious sense.

Münster Anabaptists.—In the 16th century there arose in Europe a religious sect known as Anabaptists, whose main tenets carried the principles of the Reformation to the extreme limit of that revolutionary movement. Their principles were those of revolt against mediæval feudalism just as much as against ecclesiastical authority. They were socialists as well as reformers, mystics and fanatics. Their existence was one of the results of the Renaissance as interpreted to the common mind. Their views were democratic and individualistic. They rejected all authority, all tradition, all dogma, everything in short that militated against the absolute independence of the individual mind and spirit. This tendency acquired at length the character not only of liberty but of license, and the term Anabaptist has thus become associated with every extreme, not only of license but of licentiousness, of rebellion and political outlawry. It is quite absurd to associate the term Anabaptist as employed historically with any phase of Christian thought, practice or opinion. It really is a term applied to those who at a turning point in the history of European thought, social, political and religious, became intoxicated with the idea of individual liberty, and the result was violence and excess of the worst character.

The history of the movement is as follows: The doctrine of adult baptism was first put forth by Thomas Münzer, the Lutheran pastor of Zwickau in Saxony, in the year 1520. Münzer soon obtained many followers who joined him in his uprising against all civil and religious authority. Although openly belonging to the Reformation movement they very soon became completely repudiated by the followers of Luther and his adherents. But the spirit of insurrection against feudal tyranny prevailed amongst all the common people on the Rhine, in Westphalia, Holstein, Switzerland, Flanders and throughout the whole Netherlands, and the increase of Münzer's followers became so dangerous that the magistrates and civil authorities found it difficult to restrain them. Münzer was compelled to leave Zwickau; he visited Bohemia, resided for two years at Alstadt and Thuringia and in 1524 was found propagating his doctrines in Switzerland. He was the principal inciter of the Peasants' War, which was entered upon with a view of establishing an ideal Christian commonwealth with communistic institutions. This war reached its culmination in 1525, when Münzer led his forces against the representations of established order and was defeated at the battle of Frankenhausen 15 May 1525, Münzer was taken prisoner and with several of his associate leaders was tried, condemned and executed. But all this was looked upon by the Anabaptists as merely a form of welcome persecution. New associations were formed; new prophets and teachers arose; the propaganda was extended amongst the peasants and serfs of Germany, Austria and Hungary in every direction. It may be necessary to state that the tenets of the Anabaptists are to be

summarized in their own words as follows: "Impiety prevails everywhere. It is therefore necessary that a new family of holy persons should be founded, enjoying, without distinction of sex, the gift of prophecy, and skilled to interpret Divine Revelations. Hence, no need for learning; for the internal word is more than the outward expression. No Christian is to be allowed to go to law, to hold an office in the civil government, to take an oath in a court of justice or to possess any personal property; everything amongst Christians must be in common."

John Bochhold, or Bockel, a tailor, of Leyden, aged 26, and John Matthias, or Matthiesen, a baker of Harlem, came, in 1553, to Münster in Westphalia, a town whose inhabitants followed the doctrines of the Reformation. Here they soon won the adherence of the excited populace, and among the rest, of Rothmann, a Protestant clergyman, and the Councillor Knipperdolling. The magistrates in vain excluded them from the churches. They took violent possession of the council-house, and toward the end of the year a treaty was signed securing the religious liberty of both parties. Being strengthened by the accession of the restless spirits of neighboring cities, they soon made themselves masters of the town by force, and drove out their adversaries. Matthiesen came forward as their prophet, and persuaded the people to devote gold, and silver, and movable property to the common use, and to burn all books but the Bible; but in a sally against the bishop of Münster, who had laid siege to the city, he lost his life. He was succeeded in the prophetic office by Bochhold and Knipperdolling. The churches were destroyed, and twelve judges were set over the tribes, as in Israel; but even this form of government was soon abolished, and Bochhold, under the name of John of Leyden, raised himself to the dignity of king of New Zion, as the Anabaptists of Münster called their kingdom, and as such was ceremoniously crowned. From this period (1534) Münster was the scene of all excesses of fanaticism, lust and cruelty. The introduction of polygamy, and the neglect of civil order, concealed from the infatuated people the avarice and madness of their tyrant and the increase of danger from abroad. Bochhold lived in luxury and magnificence; he sent out seditious proclamations against the pope and Luther, as well as the neighboring authorities; he threatened to destroy with his mob all who differed in opinion from him; made himself an object of terror to his subjects by frequent executions, and while famine and pestilence raged in the city, persuaded the wretched, deluded inhabitants to a stubborn resistance of their besiegers. The city was at last taken, 24 June 1535, by treachery, though not without a brave defence, in which Rothmann and others were killed, and the kingdom of the Anabaptists destroyed by the execution of the chief men. Bochhold, and two of his most active companions, Knipperdolling and Krechting, were tortured to death with red-hot pincers, and then hung up in iron cages on Saint Lambert's steeple, at Münster, as a terror to all rebels. In the meantime, some of the twenty-six apostles, who were sent out by Bochhold to extend the limits of his kingdom, had been successful in various places; and many other teachers, who preached the same doctrines, continued active in the work of founding a new empire of pure Christians, and propagating their visions and revelations in the countries above mentioned. It is true that they rejected the practice of polygamy, community of goods, and intolerance toward those of different opinions, which had prevailed in Münster; but they enjoined upon their adherents the other doctrines of the early Anabaptists and certain heretical opinions in regard to the humanity of Christ, which seemed to result from the controversies of that day about the sacrament. The most celebrated of these Anabaptist prophets were Melchior Hoffmann and David Joris. The former, a furrier from Suabia, first appeared as a teacher in Kiel in 1527; afterward, in 1529, in Emden; and finally in Strasburg, where, in 1540, he died in prison. He formed, chiefly by his bold promises of a future elevation of himself and his disciples, a peculiar sect, whose scattered members retained the name of Hoffmannists in Germany till their remains were lost among the Anabaptists. They have never owned that Hoffmann recanted before his death. David Joris, or George, a glass-painter of Delft, born in 1501, and rebaptized in 1534, showed more depth of mind and warmth of imagination in his various works. In his endeavors to unite the discordant parties of the Anabaptists, he collected a party of quiet adherents in the country, who studied his works (as the Gichtelians did those of Böhme), especially his book of miracles, which appeared at Deventer in 1542, and revered him as a kind of new Messiah. Unsettled in his opinions, he traveled a long time from place to place, till at last, to avoid persecution, in 1554 he became a citizen of Basil, under the name of John of Bruges. In 1556, after an honorable life, he died there among the Calvinists. In 1559 he was accused, though without much reason, of profligate doctrine and conduct, and the Council of Basil ordered his body to be burnt.

Undoubtedly by no means all the Anabaptists of Germany indulged in social and political excesses. The fanaticism which characterized some of the early Anabaptists is sufficiently explained by the tendency of human nature to rush into extremes. The iron hold of the ecclesiastical hierarchy, which had cramped the church for ages, being suddenly relaxed, men had yet to learn what were the genuine conditions whether of civil or religious liberty. But these considerations were overlooked, and the reformed churches, with one consent, regarded the Anabaptists with horror and disdain. The correspondence of the Reformers is full of allusions to the subject. Anabaptists are spoken of with reprobation, and a distinction is not sufficiently made between the sober Christians and the worst fanatics of the party. It is probable, at least, that their faults have been exaggerated even by the best writers.

Anabasis. See XENOPHON.

Anabolism, the building-up process of organic life. The term metabolism (q.v.) is used to express the interchange of the life process constantly going on in living plants and animals.

Anacharsis, the name of a Scythian philosopher who flourished about 600 B.C. and was a friend of Solon, by whose influence he was received into Athenian society. Returning to Scythia, he was put to death because of his performance of certain Greek religious ceremonies.

Modern readers have been familiarized with the name through J. J. Barthélmy's famous 'Voyage du Jeune Anacharsis en Grèce' (1788).

Anachronism, an inversion of chronological relation, unintended or otherwise. In common parlance it is confined to the antedating of customs or events, particularly in imaginative works with a basis of history.

Anaconda, Mont., city, the county-seat of Deer Lodge County: 27 miles northwest of Butte on the Northern Pacific, Great Northern, and Butte, Anaconda & Pacific Railways. It was founded in 1884, following the erection of its great copper-smelting works, which are the largest in the world. They treat daily between 5,000 and 10,000 tons of ore mined in the vicinity. Deposits of graphite and sapphires are found near the city. Anaconda also has large railway shops, brick works, machine shops, and other manufactories, banks, telephone and telegraph service, and daily and weekly newspapers. The Hearst Free Library contains about 6,000 volumes. Anaconda has grown rapidly with the development of its great copper industry. In 1880 it was a small mining camp; ten years later its population was 3,975. Pop. (1900) 9,453.

Anaconda (origin unknown; possibly native name), the largest snake in America (*Eunectes murinus*), sometimes reaching a length of 30 feet. It is found in or near shallow lakes and streams in Brazil, Guiana, and other parts of tropical America, where it spends much of its time in the water. It feeds on small animals, is closely related to the boa constrictor, and is not venomous. Ornamental leather is prepared from its skin, which is bright brown, marked along the back with blotches, and along the sides with rings of darker color. Compare Boa.

Anacreon, a famous Greek lyrist: b. Teos, about 560 B.C.; d. 476 B.C. Long resident at the court of Polycrates of Samos, he went to Athens in 522 and was distinguished by the favor of Hipparchus. His principal themes were love and wine, but he was a satirist as well. He was greatly esteemed throughout Greece, great honors being paid to his memory. Only two complete poems and some fragments of his works are extant, the well-known 'Anacreontea' being poems after his manner, but dating from a very much later period.

Anadir, or **Anadyr Bay**, a large inlet of Bering Sea, much frequented by whaling-vessels. It is about 250 miles wide, a peninsula of half that breadth lying between it and the Arctic Ocean.

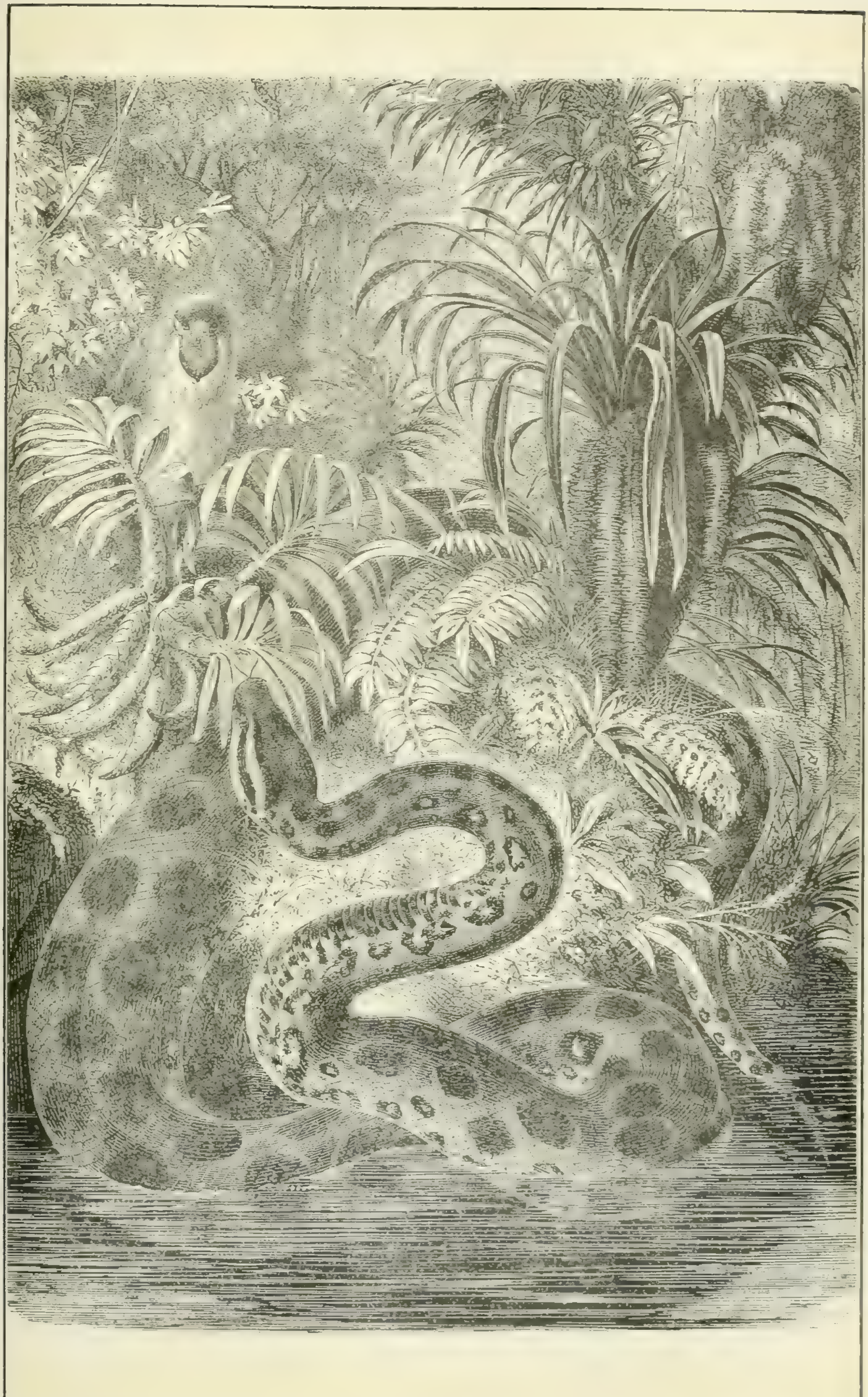
Anadir, or **Anadyr**, the most easterly of the larger rivers of Siberia. It rises in the Stanovoi Mountains, and falls into the Gulf of Anadyr after a course of some 400 miles.

Anadyomene, a surname of Venus, and referring to her as rising from the sea. It was applied by the ancients to a picture by Apelles, which represented the goddess emerging from the waters.

Anæmia, literally without blood, popularly poorness of blood. In medicine, however, it may apply to two very different classes of disease in which there may be a reduction of the amount of the blood, in its entirety, in its corpuscles, red or white, or in one particular, or important ingredient, as the red coloring matter of the blood, the hemoglobin. These two are secondary and primary anæmias. Secondary anæmia may follow a hemorrhage, long-continued wasting disease as Bright's disease, suppuration, tuberculosis, cancer, gastric ulcer; may result from inanition; may be due to the presence of intestinal parasites, notably the hook-worm disease, *Uncinaria* (the poor whites of the South, earth-eaters, etc., seem to have this disease); or may result from acute or chronic poisoning as from animal parasites, malaria; or plant parasites, the bacteria, in the acute infectious diseases; or the poison may be inorganic, such as lead, mercury, copper, or arsenic. Primary anæmia includes two diseases: Chlorosis (q.v.), the green-sickness of young girls; and pernicious anæmia (q.v.), a peculiar disease of the blood-making organs. See Blood Diseases.

Anæsthesia, the loss or impairment of sensibility, a term usually applied to the diminution or loss of the senses of touch or pain (*analgesia*, or temperature sensations), but may apply to the diminution of the sense of smell (*anosmia*), or olfactory anæsthesia; that of sight (retinal anæsthesia) taste (*agustia*), of the muscle sense, of the sense of hearing, or any of the special senses. Anæsthesia of any of these different varieties may result from injury to any part of the sensory nervous chain or neuron (q.v.). If the injury involves the external portions of the sense organs, which are different for all types of sensations, as in a cut of the wrist including a sensory nerve, the anæsthesia is termed peripheral anæsthesia; if the sensory nerve centres are affected, as in some apoplexies, it is termed a central anæsthesia. Anæsthesias may be general or local; complete or incomplete; permanent or transitory; unilateral, on one side of the body (hemianæsthesia), due to injury of the spinal cord or brain on the opposite side; or bilateral, usually due to some symmetrical lesion of the spinal cord, as in myelitis, broken back, tumor pressing on the cord, syringomyelia, locomotor-ataxia, hysteria, etc. The tracing of the nerve fibres to and from an area that is anæsthetic makes one of the most fascinating studies in medicine. Certain drugs, such as cocaine, aconitum, chloroform, ether, etc., also occasion anæsthesia. See Anæsthetics; Sensation. (References: 'Dictionary of Philosophy and Psychology,' Baldwin (1903); Flechsig & Bechterew, 'Die Leitungsbahnen im Gehirn und Rückenmark'; E. Long, 'Les Voies Centrales de la Sensibilite Générale,' 1899.)

Anæsthetics, agents used to produce anæsthesia, a word first employed by Dr. Oliver Wendell Holmes. In early times it was known that pressure on the carotid arteries on each side of the neck could bring about temporary unconsciousness and resultant anæsthesia. The gentle art of garrotting grew out of this generalized knowledge. Ancient peoples used opium, *cannabis indica*, and alcohol to produce anæsthesia, particularly analgesia, or relief from pain, but it was not until the early part of the 19th century that the discovery of the general anæsthetics, nitrous oxid, ether, and chloroform was made, and still later the wonderful develop-



ANACONDA (Eunectes murinus).

ments made in the art of local anæsthesia by the use of cocaine and its congeners.

For remedial measures anæsthesia may be local or general. Cold from ice, or from freezing mixtures, ethyl chloride, etc., is a very efficient local anæsthetic for the performance of small operations, such as opening boils, felons, etc. A large number of drugs have the power of numbing the sensory nerves of the skin and are extensively employed to relieve itching and soreness. These are mostly of the phenol or carbolic acid group, thymol, menthol, etc. Even more efficient in its action on the sensory nerve filaments is the alkaloid cocaine, obtained from the South American coca plant. Applied in appropriate watery solution (2 to 4 per cent) to the mucous membrane of the ear, eye, nose, throat, urethra, vagina, or rectum, it quickly brings about loss of all pain sensations, or, injected into the skin, causes complete anæsthesia over a circumscribed area, permitting of cutting operations. When injected into the spinal canal it brings about complete loss of pain sense in all portions of the body below the site of the injection, sometimes even more extensively. This method of inducing anæsthesia without loss of consciousness has some very advantageous features in surgical procedures and was first practised by a New York physician, Dr. J. Leonard Corning. Other related alkaloids, eucaine, holocain, have similar properties to cocaine. Still other compounds made by the synthetic chemist have been widely employed, principally as analgesics (q.v.).

General anæsthesia is usually brought about by the inhalation of some vapor. Nitrous oxid gas, chloroform, ether, ethyl chloride, etc., are those most frequently employed, especially the three former. Nitrous oxid (q.v.) was the first of this series to be suggested. It was made by Sir Humphry Davy in 1800, but was not used in practice until about 1844, when Dr. H. Wells, an American dentist, employed it in the extraction of teeth.

The anæsthetic properties of ether were known for some years before put to practical use. As to its first use there is much controversy. It seems certain that one Dr. Crawford W. Long of Georgia first used ether as a general anæsthetic, but to W. T. G. Morton, a dentist of Boston, should be given the credit for demonstrating its value and use to the medical profession. Long did his first operation under ether 30 March 1842, for the removal of a cystic tumor of the jaw. He reported his experiments to the Georgia State Medical Society in 1842. Morton's work was begun in 1846, on 30 September, when he extracted a tooth while the patient was under the influence of ether. He subsequently demonstrated his method at the Massachusetts General Hospital, and then patented his product under the name Letheon.

The following year Sir J. W. Simpson of Edinburgh announced the discovery of the anæsthetic properties of chloroform and demonstrated its value in obstetrics. At the present time all three of these anæsthetics are extensively employed. In Europe chloroform is preferred; in this country ether is used more often. The statistics of deaths following these two shows ether to be the less dangerous, although it has more disagreeable after-effects than chloroform. Chronic bronchial and kidney disease contra-indicate the use of ether, while in respect to people with weak hearts chloroform is to be avoided. See CHLOROFORM; ETHER; NITROUS OXIDE.

References: Probyn Williams, 'Guide to Administration of Anæsthetics' (New York, 1901); F. R. Packard, 'The Discovery of Ether in the History of Medicine in the United States' (Philadelphia, 1901); E. Overton, 'Studien über die Narkose' (Jena, 1901).

Anagni, a town of Italy, 40 miles east-southeast of Rome. It was the birthplace of four Popes — Innocent III., Gregory IX., Alexander IV., and Boniface VIII., and as the chief city of the Hernici was a place of importance during the whole period of Roman history. Virgil mentions it as "wealthy Anagnia." Pop. (1901) 10,059.

Anagram, a word or sentence resulting from the transposition of the letters of a given word or form of words. The most exact anagram, sometimes termed palindrome, is that formed by reading the letters backward — evil, for example, thus read, constituting live. The making of anagrams was a favorite mediæval amusement and is still an occasional pastime.

Anaheim, Cal., city in Orange County, situated in a fertile valley, 28 miles south of Los Angeles, on the Southern P. and Santa Fe R.R.'s. It is the centre of the wine trade for southern California, producing over 1,000,000 gallons annually. Anaheim has a public library, high schools, Saint Catherine's Academy, and 11 churches. It was settled in 1859. Pop. (1900) 1,456.

Anahuac, a name applied to the great central plateau of Mexico, elevated from 6,000 to 9,000 feet above the sea and including more than the area of the republic. It contains several lakes, and Popocatepetl is the loftiest of the volcanoes which rise from it.

Anaïtis, the Persian water goddess of antiquity, extensively worshipped in the East.

Anakim ("long-necked ones" = giants), a general term, like Amorites or Rephaim, used by the Hebrews for the pre-Jewish inhabitants of Palestine; but with special reference to the colossal stature accredited to them, as by others to the wild fierce tribes they encountered on first entering their adopted land. Like the Greek giants, they were mountain-dwellers (Josh. xi. 21-2), all through Judah and Israel as later divided, and apparently with palisaded strongholds at Hebron and other places. This passage says Joshua drove them thence, but that remnants survived at Gaza, Gath, and Ashdod, then or later Philistine cities. An older passage, however, says in the Authorized Version that it was Caleb who expelled "the three sons of Anak," whose names are given, from "the city of Arba [Kirjath-Arba] (the father of Anak), which is Hebron." But this is a ludicrous misapprehension of the scribe. "Sons of the Anakim" means in Oriental phraseology clans of that people, here turned into a person with personal sons. The other part is still more grotesque. "Kirjath-Arba" means "city of four" (probably from the incidents of its settlement); but the scribe has taken "Arba" for a person. If the oldest text spoke of the city of the "father of the Anakim" (that is, their ancestral home).

the metaphor is intelligible enough; but as such metaphors in the East are usually feminine, it is most likely the original said "mother of Anakim," and the copyist corrected a supposed error.

Analcite, a-nal'sīt (from the Greek word meaning "weak," in allusion to the feeble electric properties it manifests when heated or rubbed), a mineral usually classed as a zeolite, or hydrated double silicate of sodium and aluminum, with the formula $NaAlSi_2O_6 + H_2O$; although Doelter maintains that the water cannot be water of crystallization, and writes the formula thus: $NaAlSiO_4 + 2H_2SiO_3$. Analcite is commonly colorless or white, with a vitreous lustre. Its hardness is from 5 to 5.5, and its specific gravity about 2.26. It occurs in a variety of forms, but usually in trapezohedrons. There has been much controversy over its crystalline structure, owing to certain optical anomalies that it exhibits; but it is now usually referred to the isometric system, the weak double refraction that it often exhibits being probably due in part to anomalous internal stresses, and in part to a loss of water, and a consequent modification in molecular structure. Beautiful crystals of analcite are found near Mount Ætna and in Nova Scotia. In the United States the mineral occurs in the trap rocks of northern New Jersey, Colorado, California, and the Lake Superior region. See LEUCITE.

Analemma, a geometrical term implying the projection of a sphere upon the plane of a meridian with the point of sight an infinitely distant point of the radius perpendicular to that plane. This projection is sometimes styled orthographic. The sun-dial has been called an analemma, and the term has also been used to indicate a scale showing the declination of the sun and the equation of time of various periods of the year.

Analgesics, remedies used to control pain. These have come largely into use during the past 10 to 15 years. Before that time the profession had to rely chiefly on a few drugs, notably opium, cannabis indica, and their allies, for the relief of pain of nerve and muscle: neuralgia, acute rheumatism, sick headache, and other transitory or persistent affections of the sensory nerves. Synthetic chemistry has introduced a large number of new drugs that have been found very useful in allaying the pain and discomfort of many conditions heretofore borne with heroic stoicism. The commonest of these new remedies are antipyrine, acetanilide or antifebrin, and phenacetin. These are but a few of a large list of similar drugs. The numerous drug-store mixtures sold as headache powders, etc., are usually mixtures of the cheapest of these, acetanilide or antifebrin, with other products. See ANÆSTHETICS; ANTIFEBRIN; ANTIPYRETICS; PHENACETIN.

Analogue, a term in comparative anatomy employed to denote resemblances, as an organ of an animal or plant performing the same function as another part in a second animal or plant differently organized. It is much used by geologists in comparing fossil remains with living specimens.

Analogy, a correspondence of relations between one thing and another.

In logic it implies the resemblance of relations, a meaning given to the word first by the mathematicians. To call a country which has sent out various colonies the mother country implies an analogy between the relation in which it stands to its colonies and that which a mother holds to her children.

As more commonly used it is a resemblance on which an argument falling short of induction may be established. Under this meaning the element of relation is not especially distinguished from others. "Analogical reasoning, in this second sense, may be reduced to the following formula: Two things resemble each other in one or more respects; a certain proposition is true of the one, therefore it is true of the other." If an invariable conjunction is made out between a property in the one case and a property in the other, the argument rises above analogy, becoming an induction on a limited basis; but if no such conjunction has been made out, then the argument is one of analogy merely. According to the number of qualities in one body which agree with those in another, may it be reasoned with confidence that the as yet unexamined qualities of the two bodies will also be found to correspond. Metaphor and allegory address the imagination, while analogy appeals to the reason. The former are founded on similarity of appearances, of effects, or of incidental circumstances; the latter is built up on more essential resemblances which afford a proper basis for reasoning.

In zoology analogy is applied to the resemblance between the entire bodies, or between special structures of organs, in animals of unrelated types. Thus a whale is analogous in form to a fish, its paddles analogous to the fins of a fish. The wings of an insect are analogous to those of a bird. Analogy implies a dissimilarity of structure of two organs, with identity in use or function, as the legs of a bird or quadruped and those of an insect. These analogies are the result of the adaptation of the animal to similar habits, modes of life, or like environment, and result in convergence (q.v.), parallelism, and sometimes mimicry (q.v.). (See also HOMOLOGY.) Osborn defines analogy in evolution as embracing similar changes due to similar adaptation in function both in homologous and in non-homologous organs, both in related and in unrelated animals. The different grades of analogy are shown by Osborn in the following table:

ANALOGY IN EVOLUTION.

Analogous Variation (Darwin): Similar congenital variations in more or less distantly related animals and plants.

Parallelism: Independent similar development of related animals, plants, and organs.

Convergence: Independent similar development of unrelated animals, bringing them apparently closer together.

Homoplasy (Lankester) (? *Homomorphy*, Fürbringer): Independent similar development of homologous organs or regions giving rise to similar new parts.

Analogy of Religion, The, a famous work by Bishop Joseph Butler, published in 1736. The full title is 'The Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature.' The author lays down three premises,— the existence of God; the known course of nature; and the necessary limitations of our knowledge. These enable him to take common ground with those whom he seeks to convince — the exponents of a "loose kind of deism." In no sense a philosophy of

religion, but an attempt to remove common objections thereto, the work is necessarily narrow in scope; but within its self-imposed limitations the discussion is exhaustive, dealing with such problems as a future life; God's moral government; man's probation; the doctrine of necessity; and most largely the question of revelation.

Analysis, in common speech, the act of analyzing; the state of being anlayzed; the result of such investigation. The separation of anything physical, mental, or a mere conception into its constituent elements. It is also applied to a syllabus, conspectus, or exhibition of the heads of a discourse; a synopsis, a brief abstract of a subject to enable a reader more readily to comprehend it when it is treated at length.

In mathematics the term analysis signifies an unloosing, as contradistinguished from synthesis, a putting together. The analytical method of inquiry has been defined as the method of ascertaining the truth of a proposition by first supposing the thing done, and then reasoning back step by step till one arrives at some admitted truth. Analysis in mathematics may be exercised on finite or infinite magnitudes or numbers. The analysis of finite quantities is the same as specious arithmetic or algebra. That of infinites, called also the new analysis, is especially employed in fluxions or the differential calculus. But analysis could be employed also in geometry; it is therefore a departure from correct language to use the word analysis, as many do, as the antithesis of geometry; it is opposed, as already mentioned, to synthesis, and to that only.

As to analysis in chemistry, see CHEMICAL ANALYSIS.

Analytica, The, a treatise by Aristotle, is the third in that philosopher's 'Organon,' or 'Instrument,' and includes in general all that concerns the art of reasoning. Aristotle does not call his system logic, or claim to have invented it; but his theory is so perfect that no philosopher has been able to add to it any element of importance since it was first advanced. The 'Analytica' is divided into two parts: the first dealing with the form of every demonstration; the second, with the demonstration itself. In the first dissertation he treats of the terms composing a proposition, defines a syllogism, and shows how it is constructed. In the second treatise Aristotle discusses the logic of science.

Analysis Situs. Let a geometrical figure—say a closed surface in common space—be subjected to any change of form (bending, stretching, etc.) that does not involve any «tearing» or «joining.» An extensible rubber model will suggest the possibilities of such deformation. Whatever properties of our figure are unalterable by this process form the subject-matter of *analysis situs*, which may therefore be defined as the *theory of invariants of the group* (or groups, see this term) *of continuous deformations*. Its scope, however, is not confined to common space, but embraces, in general, m-dimensional figures in n-dimensional space (more briefly: R_n or n-space, also m-surfaces for m-dimensional surfaces, etc.).

The effect of *tearing* a surface or making an *incision* on it along a line, is to double the latter. As the incision proceeds it substitutes for each point P of the line two points, P_l, P_r, henceforth not to be considered as consecutive, and whose successions separately constitute the left and right edges of the incision. *Joining* is the opposite process, each point of the juncture consisting of twin points merged into one. Corresponding definitions apply to incision and juncture along surfaces of two or more dimensions, or when the elements considered are straights, planes, etc., instead of points.

It will here be noticed that figures which are not continuously deformable into one another, or *equivalent*, in n-space, may become so by virtue of the additional freedom of deformation that $n+1$-space affords. The figure of two concentric circles in a plane is not equivalent to two circles excluding one another, but becomes so in 3-space. Hence a distinction arises between *absolute* analysis situs, which places its figures in space of any suitable number of dimensions, and analysis situs *in a given space or surface* within which all deformation must take place.

C. Jordan has shown that in the case of *2-dimensional surfaces* the following four invariants form a complete system. This means that any two surfaces agreeing in these data are equivalent: (1) the number of detached portions of which they consist, and, with regard to each of these: (2) the number of curves bounding it; (3) its connectivity; (4) its laterality (unilateral or bilateral type). Evidently the first and second of these could be changed by incision or juncture only.

Connectivity.—A surface is *connected* if it permits of continuous passage on it between any two of its points. The standard of connectivity is the area of a plane triangle, circle, or equivalent figure, which is called *simply-connected* or *elementary*. On it any two curves C_1, C_2 (not intersecting themselves or each other) between two points, A, B, are equivalent, for taken together they form a closed curve which divides the plane into two separate portions. This latter property received analytical demonstration from Jordan (hence «Jordan curves») and has lately been based on the theory of assemblages by Veblen. Using Poincaré's notation we write

$$C_1 \equiv C_2 \quad \text{or} \quad C_1 - C_2 \equiv 0,$$

where the negative sign means that the curve is to be taken in the opposite direction (from B to A), and equivalence to zero means unlimited contractibility. A spherical or ellipsoidal surface is also simply connected, with this difference, that closed curves, if one obstacle (a small circle or «puncture» of the surface) be placed in the way of their contraction, may still be reduced to zero by deformation in the opposite direction. Consider, for instance, the intersection of such a surface with a movable plane as the latter moves parallel to itself in either of two directions.

Extending our definition of equivalence to zero, to sums of curves on any surface, it becomes necessary to stipulate (1) that the order of terms of a sum must be preserved (non-commutative addition) and (2) that any portions of curves, if deformed so as to coincide and form negatives of one another, shall cancel. Thus on the surface of the double ring (Fig. 1) we have

$$C_1 + C_2 \equiv C_3 \quad \text{or} \quad C_1 + C_2 - C_3 \equiv 0.$$

Curves form an *independent set* on a surface if none and no sums of them are equivalent to

zero. Curves containing portions equivalent *inter se* (as when coiling several times about a

FIG. 1.

cylinder) shall here be excluded. *Multiply-connected* surfaces are then said to have *connectivity* c if they permit of c independent paths between any two points A, B. The connectivity of a closed surface, *i.e.*, one without boundary and yet having all its points at finite distances, is not changed by puncturing it. For instance, the intersection of the double ring of Fig. 1 with a plane remains equivalent with itself (and to zero) no matter how the plane moves.

Taking B at an infinitesimal distance from A, all paths between them but those equivalent to the shortest one, approach closed curves (Fig. 2). Hence there are $c-1$ independent

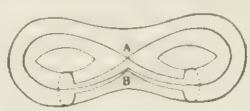


FIG. 2.

closed curves on a surface of connectivity c. Conversely, an independent set of $c-1$ closed curves does not divide the surface (for this would give rise to an equivalence between those bounding any portion of it) and can readily be so connected with two points A, B, as to form (after slight changes) $c-1$ paths from A to B, in addition to which there is the direct line joining these points.

Connectivity is often investigated by the *method of sections*. The latter are incisions of three types: (1) *cross-sections* between two points on the boundary. They may be *bound-severing*, if drawn between points of the same bounding-curve, or *bound-joining*, if between different ones. The former increase, the latter diminish, the number of boundaries by unity. (2) *re-entrant sections*, along closed curves, each furnishing two new rims; (3) σ- (sigma-) sections, starting at a boundary point and ending at a point of their own right or left edge. These contain a re-entrant section and a bound-joining section, and increase the number of bounding-curves by unity.

Limiting our investigations to surfaces any sufficiently small area of which may be considered simply connected, we may divide any one, or system of several, of them by a sufficient number (q) of cross-sections into (say, e) elementary areas. Since cross-sections start at a boundary, we must give a boundary to closed surfaces by puncturing them, *i.e.*, taking out an infinitesimal area somewhere. The difference $e-q$ then proves characteristic of our system of surfaces, and in fact is known as its *characteristic*: $K=e-q$.

To prove this, let a second division, by q' cross-sections, yield e' elementary areas. Superpose the tracings of both divisions and let there be t crossings of the proposed incisions. Then the e areas left whole by the first division will be cut $q'+t$ times by the second, or the e' areas of the second $q+t$ times by the first. Both sets of incisions thus furnish $e+q'+t=e'+q+t$ parts, which proves the proposition. We also see that the characteristic of a system of surfaces is the sum of their individual characteristics.

Any surface can be rendered simply connected by means of $1-K$ cross-sections, for let the q cross-sections which divide it into e elementary areas be traced, and let them meet in v vertices. Consider this division as a map of e districts, the traces, counted from vertex to vertex, being its frontiers. Between any adjacent districts obliterate one frontier (thereby also removing two vertices). Repeat this operation on the new map, etc., until but one district remains. By what we have proven, the totality of remaining frontiers then constitute $1-K$ cross-sections.

On the other hand the $c-1$ nearly closed curves connecting A with B (see above) can readily be turned into cross-sections if we first draw a re-entrant section in a circle of diameter AB, thereby «puncturing» the surface. Hence, on closed surfaces, $c-1=1-K$, or $c=2-K$, and if we retain this formula, the connectivity of a system of m surfaces will prove to be the sum of the individual connectivities, diminished by the number $(m-1)$ of junctures necessary to make one surface of the system:

$$c=\Sigma c_i-(m-1)=1+\Sigma(c_i-1).$$

Kronecker's researches have led to an *analytical expression for the characteristic* of a closed analytical surface $f(x, y, z)=0$. Let $f(x, y, z)$ be negative in the interior of this surface, and consider the family of surfaces $f(x, y, z)=\lambda$. As λ increases from $-\infty$ to 0, the surface has no real part at first, then, through the stage of isolated points or curves, real surfaces will develop. An isolated point develops into an ellipsoidal surface, increasing K by 2, while a closed curve (without multiple points) becomes an anchor-ring, leaving K unchanged. This, or the opposite, may occur several times as the parameter increases. Also, double points of the surface may arise, in the neighborhood of which the surfaces resemble one- or two-sheet hyperboloids, changing from the one shape to the other as the double-point stage is passed. In each of these cases the increase of K is found to be $-2\,\mathrm{sgn}\begin{vmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{vmatrix}$, sgn (signum) meaning ± 1 according as the determinant is positive or negative, and

$$f_1=\frac{\partial f}{\partial x},\quad f_2=\frac{\partial f}{\partial y},\quad f_3=\frac{\partial f}{\partial z},\quad f_{11}=\frac{\partial^2 f}{\partial x^2}=\frac{\partial f_1}{\partial x},$$

$$f_{12}=\frac{\partial^2 f}{\partial x\partial y}=\frac{\partial f_1}{\partial y},\ \text{etc.},$$

being partial derivatives.

Examples.—(1) The surfaces formed by rotation of the lemniscates

$$[(x-a)^2+y^2][(x+a)^2+y^2]-a^4=\lambda \quad \text{(Fig. 3)}$$

about the x-axis. For positive λ they present single sheets of ellipsoid connectivity ($K=2$), for negative λ, pairs of sheets of the same kind ($K=4$). Within an infinitesimal sphere about the origin the transition is from the one-sheet to the two-sheet hyperboloid, as λ decreases through zero. At $\lambda=-a^4$ the two sheets be-

come isolated points and vanish ($K=0$). (2) The surfaces formed by rotation of the same

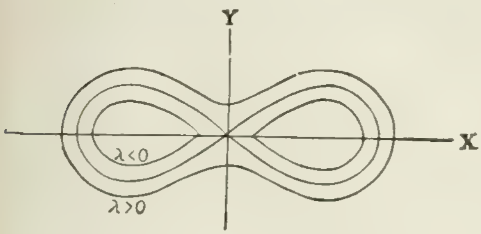


FIG. 3.—Lemniscates.

lemniscates about the y-axis. At $\lambda=-a^4$ they reduce to an isolated curve and vanish without changing the characteristic ($K=0$).

Thus K becomes $-2\Sigma\,\text{sgn}\begin{vmatrix} f_{11} & f_{12} & f_{13} \\ f_{21} & f_{22} & f_{23} \\ f_{31} & f_{32} & f_{33} \end{vmatrix}$, the sum to be taken over all points of intersection of the three surfaces: $f_1=0$, $f_2=0$, $f_3=0$. Moreover, this expression lends itself to transformation into the integral by means of which Gauss represents the «total curvature» of the surface $f(x, y, z)=0$, so that we finally get:

$$K=\frac{1}{2\pi}\text{ total curvature.}$$

Connectivity of Riemann Surfaces.—If w be an n-valued algebraic function of the complex variable z (see COMPLEX VARIABLE), let all values of z be represented on a spherical surface. Superpose radially n copies or sheets of this surface and imagine that for one value z_0 for which the n w-values are distinct, one value of w belongs to each z_0, *i.e.*, to each of the n sheets. The values $w_1 \ldots w_n$ will vary continuously with z, constituting n branches of the function w. For some values of z, however, say for $z=b_1$, $b_2, \ldots, b_m$, some among the quantities $w_1 \ldots w_n$ will turn out equal. In these points we assume connection between the corresponding sheets, and denote them as branch-points. Such connection may not be feasible where other sheets intervene. In 4-space this difficulty would not arise. Limited as we are to 3-space, we may still *suppose* passage possible in these points between the sheets in question. Further, we find that whenever, starting at z_0, we take z in a loop (in all sheets simultaneously) about a branch-point, on returning to z_0 the values $w_1 \ldots w_n$ will have undergone a permutation typical of that branch-point. We prevent such loops, and render the branches single-valued, by means of incisions through all the sheets concerned, from z_0 to each branch-point. We further join every left edge of these incisions with the right one that exhibits the same w-values. This process (which, strictly speaking, again calls for a fourth dimension) completes our Riemann surface.

If we use a circular punch to cut out neighborhoods of the m branch-points (through all the sheets), the portion punched out at b_i, where first β_{i_1} then $\beta_{i_2} \ldots$ sheets are connected, will show $n-(\beta_{i_1}-1)-(\beta_{i_2}-1)- \ldots$ distinct simply connected parts. Thus all branch-points furnish $\Sigma_i[n-\Sigma_j(\beta_{ij}-1)]$ elementary areas. The neighborhood of z_0, similarly punched out, yields n separate circles. The remainder falls into n elementary surfaces by means of m incisions from z_0 to the branch-points, through all the sheets, therefore each counting for n cross-sections. Hence

$$K=2n+\sum_{i=1}^{m}[n-\sum_{j}(\beta_{ij}-1)]-nm=2n-\sum_{ij}(\beta_{ij}-1).$$

One half of the connectivity, viz., $p=\frac{c}{2}=1-\frac{K}{2}$, is known as the *deficiency* of the surface. This is also found to be the difference between the maximal number of double points a curve of the nth order may have, and the actual number of them (d) on the curve $f(x, y, z)=0$: $p=\frac{(n-1)(n-2)}{2}-d$. Besides, p is the number of integrals linearly independent on the surface.

Laterality.—Granting that within a sufficiently small neighborhood of every point P, any of the surfaces we consider has two sides (right and left) distinguished by the two perpendiculars to be drawn from P, it may happen that some continuous path on the surface starting at P on the right side, arrives at P on the left side. The surface is then called *unilateral*; in the absence of such a possibility, *bilateral*. We have hitherto tacitly assumed the bilateral type for our surfaces.

Moebius called attention to the fact that a rectangular strip of paper $aba'b'$, if its sides ba, $a'b'$ be joined after a twist of 180°, as Fig. 4

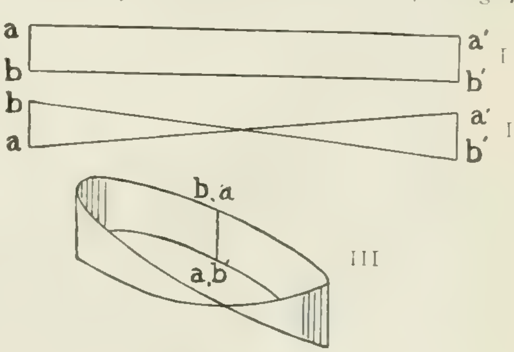


FIG. 4.—Moebius' sheet.

directs, becomes unilateral. *Moebius' sheet* may conveniently be represented by folding the rectangular strip into triangular shape as in Fig. 5. The folds may be distinguished as posi-

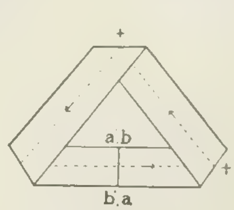


FIG. 5.

tive or negative according as, on our way from ab to $a'b'$, we pass from the lower to the upper sheet or the reverse. Each corresponds to a torsion of $\pm\pi$. Positive folds will cancel against negative ones. Evidently a strip folded into the shape of a polygon of an even number of sides will thus represent a bilateral surface; if the number of sides be odd, a unilateral one. Ruled

surfaces of the third order contain the Moebius sheet (Maschke). Closed surfaces without double points are bilateral.

Indicatrix.—The two normals at a point P, not being in the surface, are more conveniently replaced by a small circle about the point, taken in a definite (say counter-clockwise) rotation about P. On the other side (of this point's neighborhood) the same rotation will be a clockwise one about P. Similarly, within the surface two infinitesimal perpendicular straight lines may be drawn, which if produced would form a right-handed Cartesian coordinate system (see ANALYTIC GEOMETRY) on one side (which we may define as the right one) and a left-handed one on the other. Such alternating contrivances are called *indicatrices* (Klein). They may be distinguished as *right* and *left*, or as *positive* and *negative*. If constructed continuously (*i.e.*, without sudden transition to the opposite one) on continuous paths for all points that can thus be reached, one indicatrix will result for each point on a bilateral surface, while on a unilateral one a point will have both of them. Hence the term *double surfaces* for the latter type.

Unilateral Surfaces.—It will be noticed that Moebius' sheet has one continuous edge. Also,

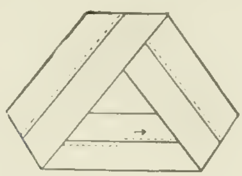


FIG. 6.

if we pursue any closed path, our direction of progress and a direction on the surface perpendicular to the former and pointing to the left may be taken as an indicatrix. Along some

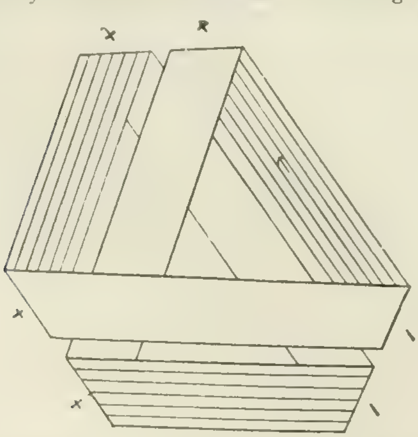


FIG. 7.—Effect of a bilateralizing re-entrant section on Fig. 6. One side is shaded.

closed paths the latter will be reversed. A line closely following such a path on its left will not close, as its beginning and end will be on opposite sides of the path. An incision along the latter evidently leaves our surface connected. Thus, on a unilateral surface, at least one non-dividing re-entrant section can be made. We shall call it a *bilateralizing* one. In fact, the number of bilateralizing re-entrant sections will be that of independent paths along which the indicatrix is reversed. This type of the re-entrant section, however, yields only one new bounding-curve. For only after completing a double circuit about the above closed path will the line following it on the left close in its turn, showing that the two edges of the incision blend into one. There also becomes possible a new kind of cross-section that leaves unchanged the number of boundaries (*bilateralizing* cross-section), as we see by merely tracing a bilateralizing re-entrant section and then making a cross-section that crosses the trace once between two points of one boundary.

Let our surface possess B bounding curves; let it become simply connected by virtue of b bilateralizing, s bound-severing, and j bound-joining cross-sections. Then $j = c - 1 - b - s$, and $B + s - (c - 1 - b - s) = 1$ or $B + 2s + b = c$. Since b is not zero, the number of boundaries of a unilateral surface will always be less than its connectivity: $B < c$.

Two Types of Unilateral Surfaces.—Draw a line connecting two points on different bilateral-

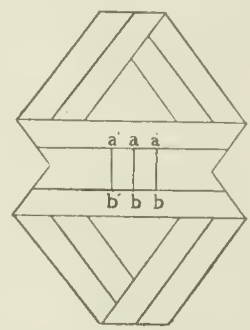


FIG. 8.

izing re-entrant sections. Make the bound-joining cross-sections $\acute{a}\acute{b}$ and $\grave{a}\grave{b}$ immediately to the right and left of it, and rejoin the re-entrant sections along the small portions $\acute{a}\grave{a}$ $\acute{b}\grave{b}$. The

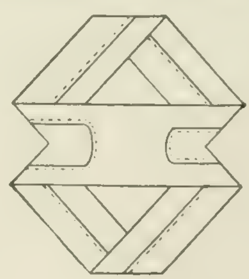


FIG. 9.

result will be a common re-entrant section. For follow by a line immediately to the left the re-entrant section from $\grave{a}$ to $\grave{b}$, the cross-section from $\grave{b}$ to $\grave{a}$, the other re-entrant section to $\acute{a}$ and, finally, the cross-section to $\acute{b}$. It will be seen that this line is closed, and so is the corresponding edge of the whole incision.

After this process of uniting bilateralizing re-entrant sections has been repeated as often as possible, if b is even, no bilateralizing re-entrant sections remain; if b is odd, there will remain

one. Accordingly, there are two types of unilateral surfaces:

(1) $R+2\left(s+\frac{b}{2}\right)=c$, b even: $K=2-c$, when the surface is unbounded ($R=0$), becomes 2, 0, -2, -4 . . .

(2) $R+2\left(s+\frac{b-1}{2}\right)+1=c$, b odd: $K=2-c=1, -1, -3 \ldots$, of $R=0$.

The above surface (Fig. 9) is of the first type, even if extended so as to lose its boundary; $K=0$. Steiner's surface, which is equivalent to the projective plane, is of the second type; $K=1$.

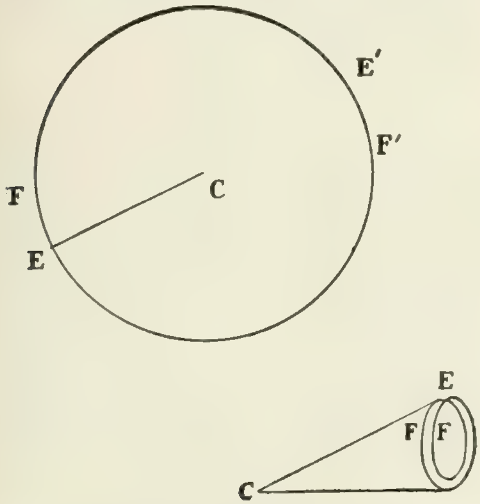


FIG. 10.—Evolution of Steiner's surface.

Steiner's Surface.—Project the points of the projective plane from a center C. On each projecting ray, whose length CP we call r, lay off the segment $\frac{r}{1+r}$ from C. The line at infinity will thus furnish a circle of radius unity, whose diametrically opposite points represent the same point (at ∞) of our plane. Now let the entire new surface, consisting of the ends of the segments laid off from C, be deformed into the plane area of this circle (Fig. 6). Cut the latter from C to E, roll it into a cone, putting CE on CE' (the edges of the incision on different sides). Join the edges of CE (creating a double line) and also, by adjacent points, the two basal circles of the cone. This second juncture, by deformation of the surface, may be made to show continuous curvature, and the apex of the cone may be made to coincide with the center of the circle of juncture. This is Steiner's surface (Fig. 11). By punching out its center and cutting by a plane perpendicular to the double line we get three elementary surfaces. Hence $K=1$, also $c=1$, $b=1$, $B=0$.

Boy has devised similar surfaces and investigated the connection between the characteristic and Gauss' total curvature in such cases.

Two connected surfaces possessing the same number (B) of bounding-curves, the same connectivity and, in case they are unilateral, the same number of bilateralizing re-entrant sections, can now be made simply connected by means of the same number of independent re-entrant sections. After a correspondence has been decided upon between the bounding curves, we draw $c-1$ bound-joining cross-sections between pairs of corresponding ones and further establish a one-to-one correspondence between the points of the original bounding curves, also of these cross-sections. The resulting simply connected surfaces will have their boundaries corresponding point for point. Schoenflies has demonstrated

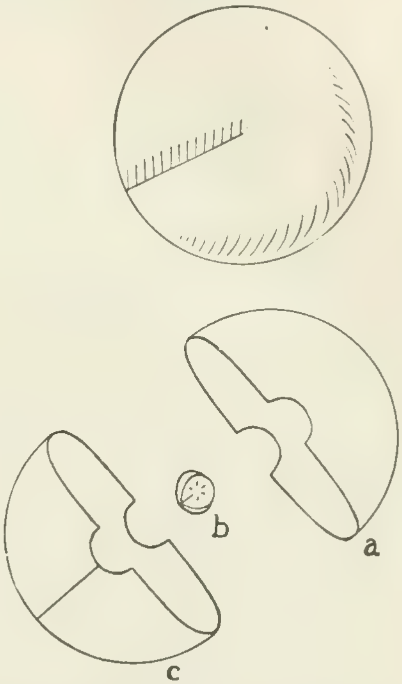


FIG. 11.—Steiner's surface and its connectivity.

that under these conditions between the points in the interior of the simply connected areas, too, a continuous one-to-one correspondence may be established. This proves our surfaces equivalent, verifying the alleged theorem of Jordan.

Space of n Dimensions.—The conceptions introduced in the analysis situs of two-dimensional surfaces in three-dimensional space permit of generalization. The indicatrix of an m-dimensional surface will consist of m directions in (*i.e.*, tangent to) the surface perpendicular to each other. There will be only two indicatrices (right and left), since we may bring about coincidence between a first pair of axes of different indicatrices, then between a second pair, etc. To do this, in the case of the kth pair, we have $m-k$-space at our disposal. This becomes a common plane for the m-first pair. For the last pair there remains a line only, so that coincidence, if not existing, cannot be forced. As a consequence, unilateral and bilateral m-surfaces must be distinguished.

Examples.—The indicatrix of a line is the line-element (or the tangent) taken in one of two possible directions. A closed curve with a cusp might be considered one-sided, as the direction here changes abruptly as we make the circuit. A four-sided prism $abcda'b'c'd'$ in R_4 can be twisted like Moebius' sheet and its face $abcd$ joined to $c'd'a'b'$. The resulting surface is bounded by one bilateral 2-surface (from ab to $cd=a'b'$ and back to $c'd'=ab$) and two

unilateral ones. We may further join these two latter 2-surfaces, their juncture only forming

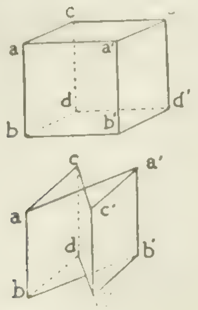


FIG. 12.

a unilateral surface such as we may imagine inside any solid. There will remain only one bounding bilateral 2-surface of spherical connectivity, just as Moebius' sheet has one edge. This further shows that an incision is possible along a surface of spherical connectivity, which does not divide our 3-surface, but renders it bilateral (bilateralizing closed section).

We shall now consider bilateral m-surfaces. They may be given by making the coördinates $x_1 \ldots x_n$ of a point in n-space, functions of m parameters $t_1 \ldots t_m$: $x_i = x_i(t_1 \ldots t_m)$. *$m$-planes* will then be linear functions. Lines, common planes, etc., are m-planes for $m = 1, 2 \ldots$

In n-space, we call surfaces ***complementary*** if their dimensions add up to n, *dual* if they add up to $n-1$. In R_3, lines and 2-surfaces are complementary, while lines are dual to lines (self-dual).

Closed m-surfaces are boundless and contain no points with infinite coördinates. They separate the dual planes of n-space into interior and exterior ones. Taking any complementary plane ($n-m$-plane) that does not intersect the closed m-surface, we can move into it any *exterior* dual plane ($n-1-m$-plane) without allowing it to intersect the surface on the way, can reverse it there by turning it through 180°, and bring it back to its original position along the path on which it was brought. An *interior* $n-1-m$-plane, if we attempted to do the same, would describe an $n-m$-surface which must intersect the given m-surface. Besides distinguishing between the interior and exterior of our closed m-surface this also shows that the interior is bilateral, the exterior unilateral, with regard to the dual planes.

Examples.—(1) The limiting case of a closed figure without dimension is a couple of points. In 1-space (straight line) it bounds a segment. It separates the straights of 2-space (common plane) into those passing between it (interior) and the exterior ones, and does the same for the 2-planes of 3-space. (2) The interior of a circular circumference is an area in 2-space; in 3-space it consists of the straight lines passing through it. Take a plane not intersecting it: an exterior straight line may be moved into the same without coming in contact with the circle, may there be turned through 180° and brought back.—Although points cannot be reversed, it is as natural in an anaylsis situs as in projective geometry to assume unilaterality for the infinite plane. This is merely to extend to a limiting case what is true generally.

Interiors of Different Orders and Degrees.—In a plane a closed curve may have overlapping portions so as to contain a certain area twice or r times. In 3-space it may, without having any double points, coil r times about certain straight lines of its interior, which thereby become an *interior of the rth order*. But if, as we follow the curve in a given direction, it coils p times in an assumed *positive* rotation about this interior of rth order, and $r-p$ times *negatively*, we may then call $p-(r-p) = 2p-r$ the *degree of the interior*. The curve C (Fig. 13) has an interior of

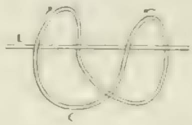


FIG. 13.—Interior of order 2 and degree 0.

order 2 and degree 0, to which line L belongs. These considerations are applicable to n-space, where $n-1$-surfaces, however, cannot possess interiors of higher orders without self-intersection (double points, etc.). Interiors of higher orders than the first can be removed by deformation, unless the curve is knotted (see below).

Locking of Dual Closed Curves.—In n-space a closed m-surface may be locked with a closed $n-1-m$-surface, as are the links of a chain. Through neither of them can a surface one dimension higher than it be laid that does not intersect the other. Examples: A point-couple and a circle enclosing one of its points in a plane. Two linked curves in R_3. For the latter, according to Gauss, the double integral

$$\frac{1}{4\pi}\iint \frac{(x'-x)(dy\,dz'-dz\,dy') + (y'-y)(dz\,dx'-dx\,dz') + (z'-z)(dx\,dy'-dy\,dx')}{[(x'-x)^2+(y'-y)^2+(z'-z)^2]^{\frac{3}{2}}}$$

x, y, z being a point of one curve, x', y', z' one of the other, has the value 1. In the case of one curve coiling repeatedly about the other, the order and degree of their interlocking may again be distinguished in accordance with the reflections of the preceding paragraph. Gauss' integral then gives the *degree*, which may happen to be 0 if the order be even. Two spherical surfaces transplanted into R_5 may interlock.

Knots.—Closed m-surfaces, in $2m+1$-space may lock with themselves. They are then said to form *knots*. The various shapes of knotted curves in common space have been extensively

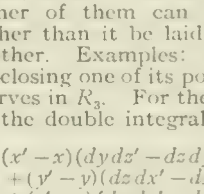


FIG. 14.—Trefoil-knot.

investigated (Listing, Tait, Simony). These researches have been referred to as *topology*, a word also used synonymously with analysis situs. The simplest knot is the so-called trefoil-knot. It is formed by a curve of the sixth order whose equation in tetrahedral coördinates

is given by Brill. It was thought that these knots might be forms of vortex-rings accounting for the differences of chemical elements. There are no knots in 4-space, surface-knots first becoming possible in 5-space, and, in their turn, dissolving in 6-space.

Generalized Connectivity.—m-surfaces will be called connected with regard to tangent lines, 2-planes, etc., if any two of these can be moved into one another without ceasing to be tangent to the surface. Two spheres in R_3, *e.g.*, are disconnected as to points, connected as to tangents and tangent planes. The opposite is true for the faces of a polyhedron. But we shall assume that the surfaces considered possess all these connectivities. With regard to any of them they may be multiply-connected. Connectivity as to points (c_1) is the special case treated above. It has been referred to as cyclosis or periphraxy (Maxwell) in the case of portions of 3-space. The interior of an anchor-ring, *e.g.*, has $c_1 = 2$.

The $c-1$ closed curves by means of which we determined the connectivity of a closed surface in 3-space will lock with other closed curves either in the space enclosed by the surface or in the exterior. We are thus led to consider the connectivity of the portion $(R_3 - S_2)$ left after subtracting from R_3 the points of our surface S_2.

Betti's Numbers of a Closed m-surface S_m.—Imagine S_m, if necessary after continuous deformation, placed in $m+1$-space. Find the connectivities $\bar{c}_1, \bar{c}_2 \ldots c_{m-1}$ of the remainder $(R_{m+1} - S_m)$ with regard to points, lines, 2-planes, . . . $m-1$-planes. These are *Betti's numbers* $P_1, P_2 \ldots P_{m-1}$ of the surface S_m, $(\bar{c}_k = P_k)$. This means that in $(R_{m+1} - S_m)$ there are $P_k - 1$ independent closed k-surfaces with which certain $m-k$-surfaces within S_m may lock. Obviously, the $m-k$-surfaces may be deformed out of S_m into the remainder $(R_{m+1} - S_m)$, while at the same time, and never ceasing to lock with them, the k-surfaces are deformed so as to be on S_m. This shows that P_{m-k} is at least equal to P_k, and vice versa, so that finally $P_{m-k} = P_k$ on any closed bilateral m-surface without double points. Betti's number P_1 for a 2-surface is at the same time its connectivity c.

Euler's Polyhedron Formula.—The theorem holds for any division of a spherical surface into simply connected districts by frontiers bounded by the vertices in which they concur, that $v - f + d = 2$, v being the number of vertices, f of frontiers, and d of districts. Such a map is *regular* if each district has the same number f_d of frontiers, and if an equal number f_v of these concur in each vertex. We have $v = \frac{2f}{f_v}$, $d = \frac{2f}{f_d}$, and $f(2f_d - f_d f_v + 2f_v) = 2f_v f_d$, where $2f_d - f_d f_v + 2f_v$ must evidently be positive. This gives rise to only five regular maps corresponding to the regular polyhedral surfaces of the tetrahedron (self-reciprocal), cube and octahedron (reciprocal to each other), dodecahedron and icosahedron (reciprocal). The regular 4-dimensional polyhedra are found to be six, viz., two self-reciprocal ones bounded by 5 tetrahedra and 24 octahedra respectively, one bounded by 8 cubes reciprocal to one bounded by 16 tetrahedra, and one bounded by 120 dodecahedra reciprocal to one bounded by 600 tetrahedra.

Euler's formula, extended to maps on closed 2-surfaces of connectivity c: $v - f + d = 3 - c$ leads to a superior limit for the number of districts that may be adjacent each to each on such a surface. Heffter has investigated under what conditions this limit is actually attained, while H. S. White shows what regular maps (called by him *reticulations*) are possible for any given c. Generalizing still further, Euler's formula for a *map* on any m-surface, *i.e.*, a division of it into simply connected parts, the dividing $m-1$-surfaces again being divided into simply connected partitions, etc., becomes:

$$\sum_{q=0}^{m-1} (-1)^q n_q = 1 + \Sigma(-1)^q (P_{m-q} - 1),$$

n_q being the number of q-dimensional parts or partitions on the map. Since for closed m-surfaces we have $P_k = P_{m-k}$, if m is even this becomes $\Sigma(-1)^q n_q = 3 - P_1 + P_2 \ldots - P_{m-1}$; if m is odd, $\Sigma(-1)^q n_q = 0$ (Poincaré).

Literature.—Since no treatise on analysis situs has been published, a few of the main papers on the subject will here be mentioned. W. Dyck (Math. Annalen, vol. 32, p. 457) gives the literature preceding his article (to 1888). The pertinent publications of the savants named above are as follows: Listing, 'Der Census raumlicher Complexe' (Göttinger Abhandlungen, 1861), and 'Vorstudien zur Topologie' (Göttinger Studien, 1847); C. Jordan, 'Sur la déformation des Surfaces' (Liouville Journal, sér. 2, 11, 1866); Klein, 'Über den Zusammenhang der Flächen' (Math Annalen 7, 1874); Moebius, 'Werke,' Band 2: 'Über die Bestimmung des Inhalts eines Polyeders' and 'Zur Theorie der Polyeder und der Elementarverwandtschaft'; Gauss, 'Werke,' V, p. 134; Kronecker, 'Berliner Monatsberichte' (1869, p. 159, p. 688, 1873, p. 117, 1878, p. 95); Betti, 'Sopra gli spazi di un numero qua lunque di dimensioni' (Annali di matematica, 1870); Tait, 'On Knots' (Trans. Roy. Soc. Edinburgh, 1879, 1884, 1886; also Proceedings of the same Society, 1876 to 1879); Simony (Math. Annalen 19 and 24); Brill (Math. Ann. 18); Heffter (Math. Ann. 38); Boy (Math. Ann. 57); Maxwell, 'Theory of Electricity and Magnetism' (vol. 1, p. 18); Veblen (Trans. Am. Math. Soc., 1905, p. 83). The subject of analysis situs of higher dimensions, especially of 4-space, has been greatly advanced by the following six recent papers by H. Poincaré: 'Analysis Situs' (Journal de l'Ecole Polytechnique, 1895); 'Complément à l'A. S.' (Proc. London Math. Soc., 1900); 'Second complément à l'A. S.' (Rendiconti del Circolo matematico di Palermo, 1899); 'Sur certaines surfaces algébriques' (Bull. Soc. math. de France, 1902); 'Sur les cycles des surfaces algébriques' (Journal de Math., 1902); 'Cinquième complément à l'A. S.' (Rendic. Circ. mat. di Palermo, 1904).

PAUL WERNICKE,
Professor State College of Kentucky.

Analyzer, the portion of a polariscope (q.v.) employed in the examination of polarized light. Nicol prisms, tourmaline plates, double-refracting crystals, and movable mirrors are each used for this purpose.

Anam, or **Annam**, an Asiatic country on the east side of the Indo-Chinese Peninsula, along the China Sea, about 850 miles long, with a breadth varying from over 400 miles in the north to 100 in the middle. It is composed of Tonquin or Tongking in the north and Cochin-China and Chiampa in the south. The total area

is 170,000 square miles, and the population 15,000,000.

Its coast is much indented, affording many fine harbors, and a mountain range extends its entire length. The Mehong, the principal river, is the boundary between Anam and Siam and is navigated by steamboats. The capital and largest city is Hué. Rice, cinnamon, sugar-cane, coffee, tea, tobacco, and cotton are the chief productions, though silk is manufactured to some extent and fine woods are exported. The government is a monarchy, the king being nominally assisted by a council of six, but French influence predominates.

The inhabitants are from two races, the Mountain Mois, and the Anamese proper, and generally under the middle size and less robust than the surrounding peoples. Their language is monosyllabic and is connected with the Chinese. The religion of the majority is Buddhism, but the educated classes hold the doctrines of Confucius; besides which there are 420,000 Roman Catholics.

Anam was conquered by the Chinese in 214 B.C., but in 1428 A.D. completely won its independence. The French began to interfere actively in its affairs in 1847 on the plea of protecting the native Christians. By the treaties of 1862 and 1867 they obtained the southern and most productive part of Cochin-China, subsequently known as French Cochin-China; and in 1874 they obtained large powers over Tonquin. By the treaty of 1884, ratified at Hué, 1886, Anam was declared a French protectorate.

Anamalai Hills, a range of mountains in the Coimbatore district of Madras, southern India. They lie between 10° 13′ and 10° 31′ North latitude and 76° 52′ and 77° 23′ East longitude. The range is rather a vast table-land with several high summits than mountains. They are covered with dense forests and the brush and jungle growths render habitation impracticable, the only inhabitants being a few wild tribes who live upon the animals which infest the woods and jungle produce. Geologically the mountains are formed of metamorphic gneiss, interspersed with veins of feldspar, quartz, and reddish porphyrite. Teak and other valuable timber may be found on the lower slopes, while a portion of the land has been planted with coffee.

Anamarita. See COCCULUS INDICUS.

Anamorphosis, a term applied to a drawing so executed as to present a distorted image of the object represented, but which, if viewed from a certain point, or reflected by a curved mirror or through a polyhedron, shows the object in true proportion.

Anamosa, Ia., a city and county-seat of Jones County, situated on the Wapsipinicon and Buffalo rivers and on the Chicago & N. W. and Chicago, M. & St. P. R.R.'s. It has a State penitentiary and many excellent quarries of building-stone, and manufactories of flour, carriages, and wagons. Pop. (1900) 2,891.

Ananchytes, a genus of fossil petalostichous sea-urchins of the family *Spatangidæ*, and subfamily *Ananchytinæ*, found in the Cretaceous formation. The name «shepherd's crown» is given to it in the southern part of England and also the name «fairy loaves.» They have a transversed mouth, an oblong outlet, a helmet-like form, and simple ambulacra.

Ananias, a member of the Church at Jerusalem, struck dead with his wife Sapphira because of an attempt to misrepresent the amount of their gifts to the Apostle Peter. The name was also borne by a Damascus disciple named in connection with Saul's adventure there, and by a high-priest in Jerusalem belonging to the Sanhedrim.

Ananier, or **Ananyer,** a Russian town about 220 miles northwest of Kherson, with some little agricultural trade and a mixed population of Russian Jews and Rumanians. It was annexed to Russia in 1792. Pop. (1897) about 17,000.

Anapa, a seaport town of Russia, situated on the Black Sea. It has been variously the possession of Turks and Russians, but has belonged to Russia from 1829. Pop. about 7,000.

Anapæst, in prosody, a foot consisting of two short syllables and one long one. In the comedies of Aristophanes it was the dominant measure, and Greek choruses employed it in their exits and entrances. From this latter circumstance it was frequently styled the marching rhythm.

Ana'phalis, a genus of plant of the tribe *Inuloideæ* of the family *Compositæ*. The characteristics are nearly the same as *Antennaria*, viz.: heads many flowered, diœcious; flowers all tubular; and the pistillate corollas are very slender. Involucre dry and scarious, white or colored, and imbricated. The receptacle is convex or flat, not chaffy; anthers caudate; achenes terete or flattish. The main difference between the two lies in the pappus, as in the *Anaphalis* the pappus in the sterile flowers is not thickened at the summit or scarcely so and that of the fertile flowers not at all united at the base; fertile heads usually with a few perfect but sterile flowers in the center. *A. margaritacea* (pearly everlasting) is found on dry hills and in the woods, is common to the northward and flowers in August. The stem is erect, corymbose at the summit, has many heads and is leafy; leaves broadly to linear-lanceolate, taper-pointed, sessile, and soon green above; the involucral scales are pearly white, very numerous, and obtuse or rounded. Consult: Gray, ‹Manual of Botany› (New York, 1889).

Anaphrodisiacs, ăn-ăf′rọ-dĭz′ĭ-ăks, are remedies that diminish sexual power or desire. They may act directly on the genital centres in the spinal cord, indirectly through the circulation on the brain, or locally on the sense organs. Inasmuch as local irritation is a frequent cause of stimulation of the sexual sense, attention to cleanliness is imperative and the removal of all sources of irritation indicated. There are many simple ways of allaying the excitement for the time, such as the application of ice, and cold baths, local or general, are of great benefit. The diet should also be regulated, spicy, stimulating, and heating foods should be carefully avoided, and the main foods should be vegetables. The clothing should be as light as possible, and if necessary drugs may be administered. Local analgesic applications, such as weak solutions of carbolic acid—1 to 2 per cent—or oxid of zinc ointment with carbolic acid, are useful. Of the general anaphrodisiacs the bromides are the best. Bromide of sodium or potassium is most frequently employed. Special medical advice is needed in the treatment of persistent sexual excitement. See also APHRODISIAC.

Anaptomorphus, a fossil lemur from the Eocene of Wyoming, allied to the modern tar-

sier. Some authorities have considered this animal as related to the ancestral line of man.

Anarchism, a theory of social organization, numbering, it is said, about one million adherents. Its doctrines represent the extreme of individualism. It looks upon all law and government as invasive, the twin sources whence flow nearly all the evils existent in society. It therefore advocates the abolition of all government as we to-day understand the term, save that originating in voluntary co-operation. Anarchists do not conceive of a society without order, but of an order arising out of the law of association, preferably through self-governing groups, for it may be said that, with here and there an exception, anarchists regard mankind as gregarious. «Our object is to live without government and without law,» says Elisée Reclus, the eminent geographer, and to-day the leading anarchist of France. Anarchists do not ignore the enormous economies resulting from the law of association, but insist that the law will be better served in a state of freedom and in the absence of all compulsion. They believe that everything now done by the state can be better done by voluntary or associative effort, and that no restraint upon conduct is necessary, because of the natural tendency of mankind in a state of freedom to respect the rights of the individual. The repression of crime, where crime might arise, could safely be left to spontaneously created organizations, such as the Vigilance Committees in early California, where no State government existed. In the view of Prince Kropotkin, the leading Russian anarchist, no cause for litigation would arise after we had abolished «the present system of class privilege and unjust distribution of the wealth produced by labor, that creates and fosters crime.»

To quote further from Kropotkin: «We are nurtured from our birth to believe that we *must* have government. Yet the history of man proves the contrary. When small bodies or parts of humanity broke down the powers of their rulers and resumed some part of their foreordained freedom, these were always epochs of the greatest progress, economically and intellectually. In the direct ratio to the freedom of the individual he advances.»

It is not easy to sum up in a few paragraphs the leading doctrines of any economic sect and at the same time retain absolute accuracy of statement. It should therefore be said that anarchists, while agreeing that the doctrine of *laissez faire* should be extended to all departments of human activity, are by no means in agreement on all points. There are evolutionary and revolutionary anarchists, and communist- and individualist-anarchists. The point on which all are agreed is in their opposition to compulsory forms of government, and in regarding the necessary despotism of majorities in a democracy as only a little less hateful than the despotism of a monarchy. «Governments are the scourge of God,» says Proudhon, with whom the philosophy of modern anarchism may be said to have begun.

Pierre Joseph Proudhon was born in Besançon, France, in 1809, and died in 1865. Germs of the doctrine of which he is the founder may be traced to much earlier, even ancient periods. Among his modern precursors is William Godwin (b. in Wisbech, England, 1756; d. in London, 1834), who is better known as the author of the novel, 'Caleb Williams,' but who in his 'Inquiry Concerning Political Justice,' which appeared in 1793, advocated the abolition of every form of government, and formulated the theory of anarchistic communism. But modern anarchism as a force in sociologic thought began with the publication of Proudhon's famous essay, 'What is Property' (1840). In it he rejects all law and authority, but in a work which appeared in 1852 entitled, 'The Federative Principle,' he seems to have modified in a measure his former theory of government and favors the formation of self-governing communities. In the former work occurs the phrase which is destined to be forever associated with the name of Proudhon, but which was uttered by the Girondist Brissot a half century earlier, «Property is robbery.»

It was upon the notion that he had furnished a demonstration of this thesis that Proudhon especially prided himself. But this phrase as used by the father of anarchism must be held to apply rather to modern methods of acquisition than to property itself, for Proudhon was an individualist, not a communist-anarchist, and strove, however unsuccessful he was in making himself understood, rather to refine than to destroy the idea of property. In all his reasoning on this point there is much dialectic subtlety, of which, with perverted ingenuity, Proudhon was overfond; but it may be said that what he really sought was the overthrow of all prevailing theories of property with a view to rendering it unassailable from the standpoint of exact equality and social justice. A few years later the doctrines of anarchism in the hands of Michael Bakunin underwent a change from the advocacy of a purely peaceful revolution to one of force. Bakunin was born 1814, died 1876. He was prominent in the Paris Revolution of 1848, was surrendered to Russia and sent to Siberia, but succeeded in making his escape. His principal work, in addition to innumerable pamphlets and addresses, is 'Dieu et l'État.'

«The propaganda by action,» as it is termed, by which it was hoped to inspire such dread and horror as to compel the adoption of measures of social amelioration, or perhaps the overthrow of the state itself, has borne abundant fruit in the attempted assassination of Emperor William in 1878, in the attempt upon the life of the German princes in 1883, in the assassination of President Carnot, of France, in 1894, of the Empress Elizabeth, of Austria, in 1898, of King Humbert, of Italy, in 1900, and of President McKinley, by Czolgosz, in the autumn of 1901. Other anarchist crimes were the throwing of a bomb in the French Chamber of Deputies, in 1893, by Vaillant, and the bomb explosion in Paris, caused by Emile Henry, in 1894.

The Haymarket tragedy of 1886, in Chicago, by which a number lost their lives in an explosion from a bomb thrown by some unknown hand, and which resulted in the trial and conviction of seven professed teachers of anarchism in that city, four to the gallows, two to life imprisonment, and one to a term of 15 years, aroused the attention of the whole civilized world. It is now seen, after the lapse of 17 years, that these men, even if dangerous to the community, were convicted more largely by the existing state of public terror than by any actual evidence connecting them with the throwing of

the bomb. The fact that the pardon of the three who escaped the gallows was petitioned for, after the terror of the time had died away, by some of the most prominent citizens of Chicago, is proof of the change the public mind underwent regarding the accused. The controversy over the justice of their conviction is still unsettled. With these acts of murder and vengeance the purely economic doctrines of anarchism have of course no relation. "The propaganda of action" is repudiated by those who are sometimes termed "philosophical anarchists," to distinguish them from the revolutionary wing. These are represented in this country by Benjamin R. Tucker, in France by Elisée Reclus, and in England by Auberon Herbert. ("It is a mistake to believe that the anarchist idea can be advanced by acts of barbarity."— Elisée Reclus.) This school regards force as fundamentally at war with their ideals. It does not believe that the social revolution can be accomplished by the methods of Bakunin and his school. Proudhon never preached force.

With the policy of "propaganda by action" in this country is linked the name of Johann Most, a former member of the German Reichstag; in France, that of Charles Malato ("I love and admire Vaillant just as some English Republicans love and admire Cromwell, who was also a regicide" — Charles Malato); and in Italy, that of Enrico Malatesta, an anarchist, like Kropotkin, of noble family. ("It seems to me that in the natural order of evolution violence has as much a place as the eruption of a volcano. All great progress has been paid for by streams of blood. I cannot see how the present conditions based upon force can be changed in any other way than by force, and so long as they use force against us we must in self-defense employ violent methods."— Enrico Malatesta.)

As Proudhon was the father of anarchistic individualism, Kropotkin is as indisputably the father of anarchistic communism. Theoretic anarchism for some time subsequent to the advent of its French founder was rigidly individualistic. Max Stirner, a follower of Proudhon in Germany, whose philosophy was more of a blank negation than that of his master, pushed the ego to a point where it more resembles a caricature than a dogma, and Bakunin hated the idea of communism. But in Kropotkin it must be said that the idea of property has reached its disappearing point, and the ideal of anarchism is at the last purely communistic. Kropotkine's life and his romantic career, united with the vast store of knowledge he possesses, give to his professions of anarchism a fascination and a weight. And amiable as is his personality, he is not unsuspected of a sympathy with the Bakunin school of action.

Among the works on anarchism not previously mentioned are Kropotkin's 'Paroles d' un Révolté' and 'La Conquête du Pain,' with a preface by Elisée Reclus, and the latter's 'Evolution et Revolution'; 'The Individual and His Property' by Max Stirner; 'Société Mourante' and 'Société au Lendemain de la Revolution'; 'Declarations' (Paris), by G. Eliévant, a work highly regarded by anarchists; 'Après la Tempête,' by Herzen; magazine articles by Auberon Herbert; and 'Instead of a Book,' by Benjamin R. Tucker. 'Anarchism, Its History and Theory,' by E. V. Zenker, is a work valuable for its thoroughness and its judicial impartiality; 'Die Theorie des Anarchisimus,' by Rudolph Stamler, may be consulted with profit for an examination and refutation of the theories and arguments of anarchism. Among the works closely allied to anarchistic thought should be included the sociologic romance, 'Freeland,' by Theodor Hertzka, of Austria.

JOSEPH DANA MILLER.

Anastasia, Saint, the name of three Christian martyrs. (1) A virgin said to have been a pupil of SS. Peter and Paul, and slain under Nero (54–68 A.D.). She is commemorated 15 April. (2) "The Younger," martyred under Diocletian, 303; wife of one Publius, a pagan, who himself laid an information against her. Two alleged letters of hers in prison have been preserved. The Greeks commemorate her the 22d of December, the Latins the 25th. (3) A Greek maiden of Constantinople, whom Justinian (about 597) sought as a mistress. To escape him she fled to Alexandria and lived there disguised as a monk for 28 years. She is commemorated 10 March.

Anastasius, the name of four Popes, the first and most eminent of whom held that office 398–401. He enforced celibacy on the higher clergy and was a strong opponent of the Manichæans and Origen. Anastasius II. succeeded Gelagius I. in 496; d. 498. Anastasius III. filled the papal chair 911–913. Anastasius IV. was Pope 1153–1154.

Anastasius I., an emperor of the East who succeeded Zeno, A.D. 491, at the age of about 55: b. about 438; d. 518. He distinguished himself by suppressing the combats between men and wild beasts in the arena, abolishing the sale of offices and building the fortifications of Constantinople. His support of the heretical Eutychians led to a dangerous rebellion and his anathematization by the Pope.

Anastasius II., an emperor of the East who was raised to the throne in 713. Attempting various reforms, he was deposed in 716 and became a monk at Thessalonica.

Anastasius, a romance by Thomas Hope, (1819). The author was known to have written some learned books on furnishing and costume; but 'Anastasius' gave him rank as an accomplished painter of scenery and delineator of manners. Anastasius, the hero, a young Greek ruined by injudicious indulgence, is haled before a Turkish magistrate. Discharged, he fights on the side of the Crescent and goes to Constantinople, where he resorts to all sorts of shifts for a livelihood,— jugglery, peddling, nostrum-making; becomes a Mussulman, visits Egypt, Arabia, Sicily, and Italy, and finally dies young, a worn-out and worthless adventurer. The book has passages of great power, often of brilliancy and wit; but belongs to the fashion of a more leisurely day and is now seldom read.

Anastatic Printing, a process by which a facsimile of a page of type or an engraving, old or new, is reproduced in the manner of a lithograph or page of letterpress. The print or page to be transferred is dipped in diluted nitric acid, and, while retaining a portion of the moisture, laid face downward on a polished zinc plate and passed through a roller-press. The zinc is immediately corroded by the acid contained in the paper, excepting on those parts occupied by the ink of the type or engraving.

The ink, while rejecting the acid, is loosened by it and deposits a thin film on the zinc, thus protecting it from the action of the acid. The result is that those parts are left slightly raised in relief, and the plate being then washed with a weak solution of gum, and otherwise treated like a lithograph, the raised parts, being greasy, readily receive ink from the roller and give off a facsimile impression of the original.

Anastomosis, in anatomy the joining of the branches of a vessel with other vessels of the same or a different branch. Anastomoses are found in the arteries, veins, and lymphatics. Anastomoses of nerve and muscle fibres are also spoken of.

An'atase, a mineral more correctly known as OCTAHEDRITE (q.v.).

Anath'ema, a word used in a form of excommunication from the Church. It is properly a Greek word, and was originally applied to an object set apart and devoted to a deity, such as a gift hung up in a temple (being derived from the Greek *anatithēmi*, I lay up); but it gradually came to mean separation from God and men, something accursed; and latterly to pronounce an anathema, to anathematize, became much the same as to curse. *Anathema* occurs repeatedly in New Testament Greek, in the English version being generally rendered "accursed," but once the original word is retained (1 Cor. xvi. 22) along with *maranatha,* the latter serving apparently to intensify the curse, though it is properly a Syriac expression signifying "the Lord will come." The Greek and Roman Catholic Churches both make use of the anathema. In the latter it can be pronounced only by a Pope, council, or some of the superior clergy. The subject of the anathema is thus declared an outcast from the Church. When councils declare any belief heretical the declaration is couched in the following form: *Si quis dixerit,* etc., *anathema sit,* "If anyone says (so and so) let him be anathema." The anathema was thus pronounced by the Vatican Council against opponents of the doctrine of papal infallibility. In the Middle Ages the anathema was freely used. See EXCOMMUNICATION.

Anathoth, a town in Palestine, assigned to the Levites, the birthplace of the prophet Jeremiah and the home of Abiathar the high priest. It was about three miles northeast of Jerusalem, and the small village of Anata occupies its site.

Anat'idæ, a family of swimming-birds, including ducks, swans, geese, etc. See ANSERES.

Anato'lia, the modern name of Asia Minor. See ASIA MINOR.

Anatomy, literally a cutting up; but anatomy usually signifies the special study of the structure of organic bodies, morphology (q.v.) and applies to both animals and plants. Animal morphology is the study of human or other animal forms, the study of the relationship between the forms constituting Comparative Anatomy (q.v.). The study of the minute or microscopical anatomy is termed Histology (q.v.). Developmental Anatomy is the study of the gradual growth of the animal, Embryology (q.v.). In the plant world there are also the correlated branches of Plant Morphology, Comparative Anatomy, Histology, and Embryology. The study of the microscopical structure of the single cell is termed Cytology; of collections of related cells and tissues constituting organs, Organology; thus the study of the bony system is termed Osteology, of the structures of circulation Angiology, of nerve structures Neurology, of the muscles Myology, of the viscera Splanchnology, etc. Each in its turn has its special departments of investigation.

The study of anatomy may be approached from the purely descriptive side, Descriptive Anatomy, or may deal with the anatomy of related organs in related animals, as Systematic Anatomy. Applied or Practical Anatomy, or that branch dealing with its study as an aid in the diagnosis and treatment of disease, may be designated as Medical or Surgical Anatomy. Regional and Topographical Anatomy deals with the study of special parts or the special relations to surrounding parts. The larger study of anatomy in its general philosophical relations to the general questions of structure is termed Philosophical or Transcendental Anatomy.

History.— The beginnings of human knowledge of the structure of organic bodies are preserved from the earliest times in fragments only, but there are very good reasons for believing that much more was known many thousands of years before the Christian era than there is written evidence to substantiate. The history of anatomical study is correlative with the history of medicine, and even in very early times inquiries were made concerning the structure of the human and animal body.

It is usual to ascribe to the Greeks the first foundations of anatomical knowledge, but it seems that Chinese culture, which was highly developed when the peoples of Europe were in a very primeval condition, had a well systematized medical lore that included much exact pharmacological knowledge, with some few anatomical facts, although the anatomy of the early Chinese was largely speculative. Section of the human as well as lower animal bodies was forbidden by at least two of the religious sects of early Chinese culture, the Alman and Buddha worships. It is interesting to note that as early as 2838–2699 B.C., Shinnong was a half-mythical medicine man in China, and it is said that Chinese works on medicine were written as early as 2698–2599 B.C. (Hwang Ai).

In India the sacred work of the Ayur Veda, supposed to date from between the 14th to the 9th centuries B.C., at least 100 years before the cult of Æsculapius had begun, contains descriptions of the human body obtained from dissections, and it may be that Charaka and Susrutu, the earliest of Indian physicians, should be considered the earliest anatomists. Egypt contributed somewhat to the knowledge of anatomy, and the Papyrus Ebers, 1553? B.C., is a monument of old Egyptian medicine. It is of interest to note that some of the Hippocratic nomenclature of anatomy is of Egyptian origin. The influence of religion, however, was very strong in the shaping of Egyptian medicine. Evisceration was largely practised and undoubtedly led to the collection of many anatomical facts the importance of which has become lost to students. It is certain, however, that the school of medicine situated in Greece, on the island of Cos, laid the firm foundations of our knowledge of anatomy. It was in Greece also that the physician's profession was amply recognized. This early Hippocratic

age gave rise to a professional conscience, and the "Physician's Oath," or the "Hippocratic Oath," "is a monument of the highest rank in the history of civilization." (Gomperz: 'Greek Thinkers.')

There were at least seven physicians with the name of Hippocrates who taught in the early times. Hippocrates II. (430 B.C.), however, was the great Hippocrates, but the knowledge of anatomy then possessed must be considered as the accumulation of the school rather than the work of any one man, for, as has already been pointed out, some of the Hippocratic nomenclature is Egyptian in origin. (v. Oefele.) Inasmuch as the Hippocratic writings are partly preserved, a better idea of the anatomical knowledge of the times may be gathered from them than from the mythical, traditional, and fragmentary remnants left by other peoples. The school of Cos had a fairly accurate and extensive knowledge of the human skeleton, and they knew the general shapes and varieties of most of the internal organs. Their physiological hypotheses, however, were crude but suggestive.

From the time of the great Hippocrates the school of Cos seemed to deteriorate, although Polybus, the son-in-law of Hippocrates II., Syennesis, Diogenes, and Praxagoras, the last named being noted for his anatomical knowledge, kept alive many of the traditions of the school. With Aristotle (384–323 B.C.) there came a period of more exact science and the dissection of the lower animals was practised, hence Aristotle may be termed the father of Comparative Anatomy. His researches in anatomy were wide and deep and his work on animals contains much that is still taught.

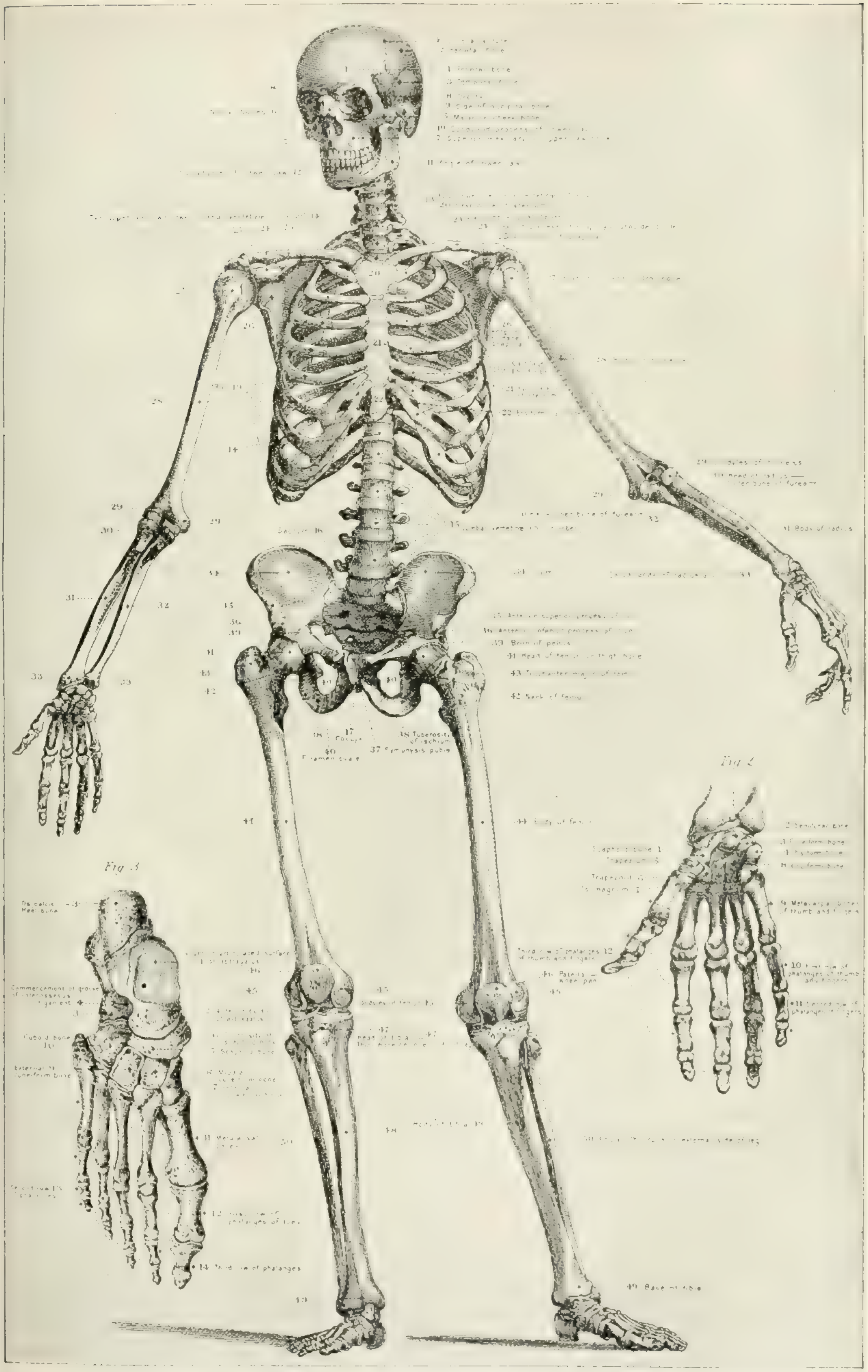
The Alexandrian period, 300 B.C., during which the culture of Rome and of Greece was encouraged in Egypt under the Ptolemies, shows as a bright spot in the history of anatomical science. With the foundation of the Alexandrian Museum, the analogue of a modern university, the practice of human dissection became authorized. This period was a brilliant one in the history of medicine. Herophilus and Erasistratus were among the early leaders, the former making some noteworthy contributions to the knowledge of the anatomy of the brain. He maintained that it was the organ of thought and the origin of motion. He also described the lacteals and the lymphatics, and was an indefatigable searcher for the seat of the soul, which he placed in the floor of the fourth ventricle of the brain, the place now known to be the site of the cranial nerves, that are indispensable for the function of breathing. Herophilus also is credited with the destruction of the old doctrine that the arteries held air, hitherto the veins only having been thought to contain blood.

Erasistratus first described the valves in the veins, made the general subdivision of sensory and motor nerves, and drew the generalization of the relation of the complexity of the brain convolutions and mental development. He also first suggested the thought of anastomoses between the arteries and veins. Many others followed, but the rise of the Empirical school (q.v.) was the forerunner of the gradual decay of the Alexandrian school. It was to the newly arisen empire of Rome that the stream had turned, and until the time of Cato Greek physicians flourished in Rome. Asclepiades (126–56 B.C.) was one of the founders of the Atomic school at Rome, and Rufus (97 B.C.) of Ephesus, with A. Cornelius Celsus (25 B.C.–40 A.D.) were among those who have left definite anatomical landmarks. Celsus is known as a brilliant man, a compiler of the work of his predecessors. His anatomical work was insignificant, but he contributed largely to therapeutics. The last dying ember of this Alexandrian transplanted school showed in Claudius Galen, a Greek from Pergamos, a town already noted for its Æsculapian temple. Galen was a man of great brilliancy, an independent thinker, and it was to his literary efforts that much of the history and treatment of the Hippocratic school has been preserved to us. His works on anatomy alone were at least fifteen in number, nine of which are preserved. Galen systematized much of the anatomical knowledge of the time, and although much of his data was drawn from the study of apes it was to pass muster in the service of human anatomy. He was perhaps the first to make any experimental physiological studies. His descriptions of the relations of the brain to the spinal cord and his knowledge of the cranial nerves were in advance of his predecessors. Galen's work stands out as the last systematic work of the Greek period, and following his death began the dark era of the barbaric inroads of the northern races and the dispersal of the culture of the East.

For a period of many centuries history is comparatively silent on the subject of medicine. No great schools arose, yet the doctrines of the ancient Greeks were kept alive in many places by obscure scholars and by many peoples, although it is known that the Saracens were largely instrumental in keeping intact that which Galen had handed down, without adding much, however, to his teachings. A flourishing intellectual development took place in the Byzantine countries, and many universities were founded by the Arabs, where the Roman-Hellenic culture was mingled with the Christian-Oriental ideas to found a new culture. Among the most famous of the Oriental physicians was Sergios von Resaina (536). He translated both Galen and Hippocrates into Syrian. Oreibasios was also a commentator of the Greeks; Avicenna (980–1036) was the Galen of the Orientals. This period of medical history has been called the Arabic period, and not until the influence of the crusades commenced to make itself felt did the period of the Renaissance begin.

The history of medicine (anatomy) now becomes more and more multiplex; new schools begin to be founded. Salerno, Naples, Montpellier, Venice, Bologna, Prague, Vienna, and Oxford successively built universities and attracted the ablest minds in medicine. Scholars traveled from university to university to learn from a professor here and a professor there, and the fortunes of the universities rose and fell like the tides of the sea. In 1224 it is said that the University of Bologna alone had 10,000 students. Among the early names of this period of transition may be mentioned Lisfranc (1295); Mondino (1275–1327), who wrote the first anatomy since the time of Galen, and which reached 25 editions,— he also suffered persecutions for his zeal in dissecting; Linacre, (1461–1524) of England, was one of the earliest scholars to bring the results of the new awaken-

ANATOMY—I. THE HUMAN SKELETON.



ing to Oxford and to Cambridge; and Sylvius, or Jacques Dubois, a Frenchman, was another of these great early anatomists of the reconstruction period. Sylvius first arranged all of the muscles of the human body and gave them the names which, for the most part, they now carry.

Andreas Vesalius (1514–1564), a Belgian, first studied at Louvain, and later became a pupil of Sylvius at Paris. At the age of 22 he became professor of anatomy at Padua, and at 29 issued a monumental work on anatomy, the best that had been given up to that time. He corrected many of Galen's errors and had a checkered career. General gross anatomy under Vesalius, who was a son, grandson, and great-grandson of a physician, began to assume more definite shape. In his student days at Paris under Sylvius, anatomy was taught upon the animal cadaver. Sylvius, however, was an uncompromising Galenist, and, although he made dissections, he followed Galen's treatises in very servile fashion. He was practically the last of his school, and his doctrines were swept away by the light thrown by this indefatigable seeker after truth as drawn from nature rather than from books. "My study of anatomy," said he, "would never have succeeded had I, when working at medicine at Paris, been willing that the viscera should be merely shown to me and to my fellow students at one or another public dissection by wholly unskilled barbers, and that in the most superficial way. I had to put my own hand to the business." Human dissection was rapidly and superficially practised, but Vesalius is known to have haunted cemeteries and gibbets to obtain human material. The results of his studies were published in 1543 in his masterpiece, 'De Humani Corporis Fabrica. Libri VII.,' the first of a long series of more distinct modern treatises on physiology as well as anatomy. Vesalius may truly be said to have been the founder of modern biological science. "He brought into anatomy the new spirit of the time, the young men of the time who listened to the new voice."

Of the contemporaries of Vesalius many were almost as famous as he. Eustachius at Rome, and Fallopius at Paris, Ferrara, and Padua corrected many of Vesalius's details, and Eustachius may be said to have been the first to call attention to the study of embryology as an aid in the interpretation of gross anatomy. Both Eustachius and Fallopius made noteworthy additions to the knowledge of the ear. These were the days of enthusiasm in the discovery of new facts, and so great was the striving for the new culture that it is said that criminals were utilized for purposes of experiment and dissection, probably after smothering. A large coterie of brilliant men lived at this time. Servetus (1509–1553), a Spaniard, first made out many of the true facts of the pulmonary circulation. Cæsalpinus (1517–1603), a highly cultured scholar and a great botanist, was among the first to speak of the circulation of the blood. Varolius (1543–1575), furthered the knowledge of the anatomy of the nervous system. Spigelius (1578–1625) made noteworthy studies of the liver. Realdo Colombo (1494–1559), who succeeded Vesalius at Padua, and was subsequently professor of anatomy at Pisa, filled out the outline of Servetus. Some authorities claim that he stole the ideas and correctly described the pulmonary circulation, although he did not appreciate the corollaries of his discovery. He imitated Vesalius and his work in a bold reproduction of his friend's studies; and Fabricius (1537–1619), who succeeded Fallopius at Padua, built a special anatomical amphitheatre where he taught anatomy to England's great anatomist Harvey.

The time had now come for a mind who could take this accumulating mass of anatomical facts, which after all were extensions in detail only of the old Hippocratic anatomy, and to discover new physiological principles, for it was noteworthy that although newer and better ideas of structure had been given, yet many of the old notions of function were still taught.

This was done by William Harvey of England. He was born in 1578, studied at many universities, mainly at Cambridge and Padua, and in 1615 first clearly demonstrated the correct action of the heart and interpreted the history of the circulation of the blood. Harvey's old anatomical preparations of this age are still in existence. From this time onward newer interpretations were possible, and the study of anatomy and physiology, now correctly linked, made rapid strides. These newer vantage grounds of interpretation were further extended by the discovery of the microscope, and by this instrument the field of microscopical anatomy, or Histology (q.v.), was opened up, leading to far-reaching and important results to the welfare of mankind. The period of detailed and special advance may be said to have been foretold in the newly revived study of physics by Borelli and his school, and the newer chemistry of Van Helmont won from the mysticisms of alchemy. These united to interpret the results of anatomical research, and the general history of the subject of anatomy widens out, fan-like, into its several specialties. The subject of anatomy now becomes lost in the history of interpretations and applications, and the further developments of these are considered in these volumes under their special heads where the developments of the various branches of anatomical research are considered. Consult ANATOMY, COMPARATIVE; ANTHROPOLOGY; BIOLOGY; CHEMICAL PHYSIOLOGY; CYTOLOGY; EMBRYOLOGY; HISTOLOGY; PATHOLOGY; PHYSIOLOGY; SURGICAL ANATOMY.

Bibliography.— The most extensive of modern works on the history of anatomy is found with complete bibliography in Neuburger and Pagel's 'Handbuch der Geschichte der Medicin,' (2 vols. 1903). See also Buck's 'Reference Handbook of the Medical Sciences' (11th ed. N. Y. 1902); Roswell Park's 'An Epitome of the History of Medicine' (1897). Of descriptive anatomies there are many: Testut and Poirier in French; Bardelben and Spalteholz in German, the latter translated by Barker into English in 1903; Morris, Quain, Gray in English; Leidy, Gerrish, and Huntington in America. The bibliography of the special subjects will be discussed in their sections. See MEDICINE, HISTORY OF.

SMITH ELY JELIFFE, M. D.,
Editor 'Journal of Nervous Diseases.'

Anatomy, Comparative, is that subdivision of the science of zoology which deals with adult forms and structures of animals with a view to determining their relationships. Comparative Anatomy and Embryology, the latter dealing

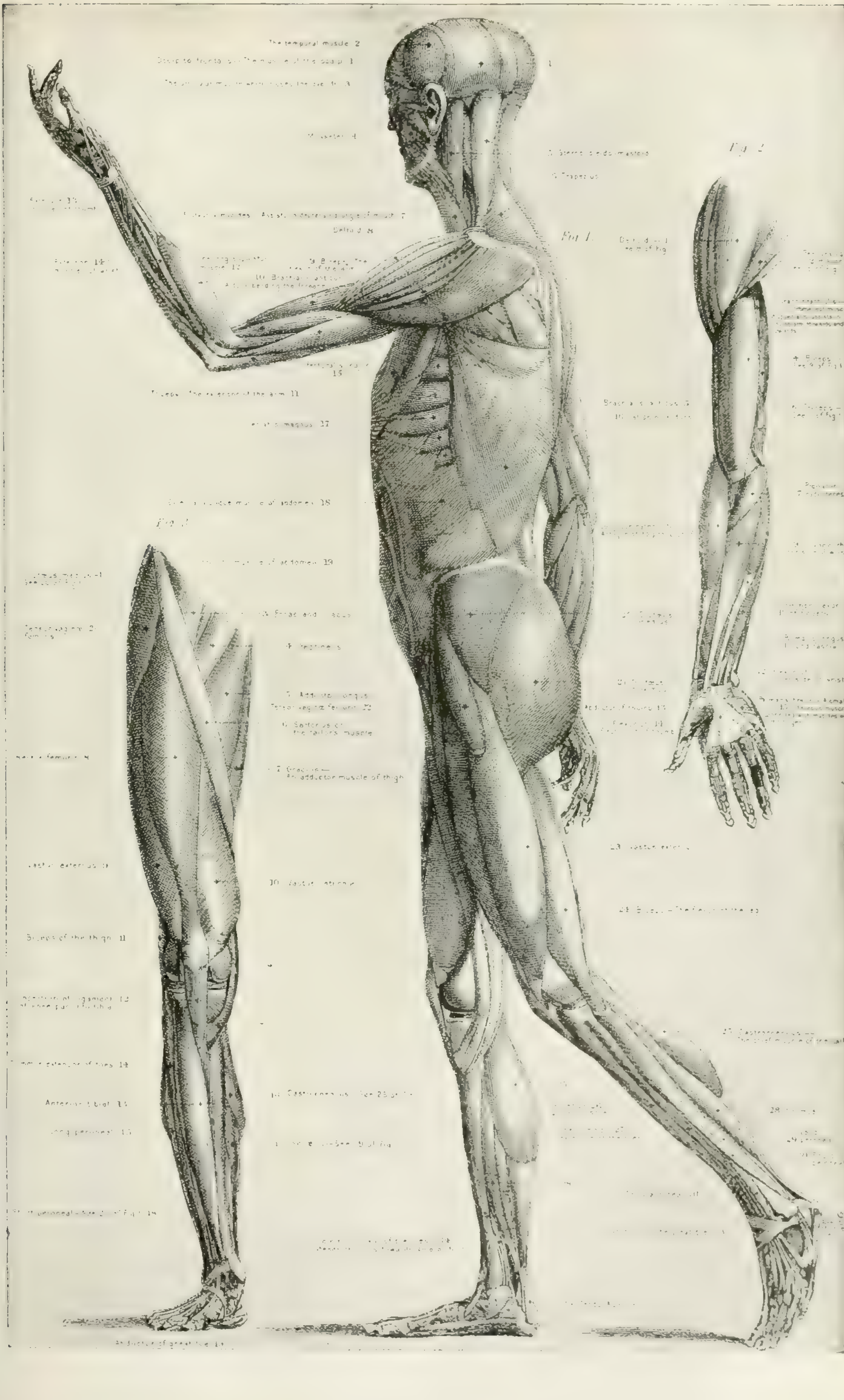
with the immature forms and structures of animals, constitute the science of Morphology, which treats of the structure, development, classification, and relationships of animals as contrasted with Physiology, which deals with their functions. In contradistinction to special anatomy, which has for its aim the description of all the structures and parts of any one animal,— for example, man,— the method of comparative anatomy is to compare corresponding parts in many different species, noting their modifications and transformations with the ultimate purpose of determining the affinities or relationships of these species to one another. In the earlier history of this science the expressions "relationship" or "affinity" were used in a metaphorical sense, signifying merely relative positions in a system of classification. With the growth of the evolution idea, however, they have acquired a new and literal meaning, since the aim of modern morphology is to determine the genetic or blood relationships of animals to one another and thereby to trace the evolution not only of the species but also of the various organs and parts. The great value of the comparative method in science is nowhere better illustrated than in the study of anatomy. There are probably not fewer than 1,000,000 known species of animals belonging to at least 10 or 12 distinct types. These animals exhibit the various organs of animal life under a great variety of forms, and bv means of comparison it is possible to determine in each case what is universal and essential and what is merely local and accidental, and also to indicate the steps by which complexity of organization has been attained. Furthermore the comparative method throws a flood of light upon the significance of problematical and rudimentary structures such as the thyroid, the thymus, and pineal glands of man, the purpose of which so puzzled the earlier anatomists. In fact it may fairly be said that it is impossible to properly comprehend any structure of the human body without considering it in relation to similar structures in other animals.

I. Principles of Comparative Anatomy.— It is obvious that in the study of animals various standards of comparison might be employed; for example, they might be compared as to color, size, or length of life, but it is at once apparent that such comparisons would bring together animals of the most diverse characteristics in other respects. As contrasted with such a purely artificial classification it was long the aim of naturalists to find a natural system expressing the "affinity" between organisms which could frequently be better felt than described. It was the great merit of Cuvier, often called the founder of comparative anatomy, that he insisted upon the importance of comparing the totality of the internal structures as well as the external characteristics of animals. By means of such comparisons he reached the conclusion that there were four great independent branches or types of animal organization, namely, *Vertebrata, Mollusca, Articulata, Radiata,* each consisting of forms fundamentally like one another but unlike those of other types. The principal criterion used by Cuvier for determining this fundamental likeness or unlikeness was the relative positions of corresponding parts, particularly of the nervous system. "The type is the relative position of parts" (Von Baer). Richard Owen, a pupil of Cuvier, introduced the term homology to describe this fundamental likeness, defining it as "morphological correspondence in the relative position and connection of parts." He contrasted with this physiological correspondence of parts, which he named analogy. In closely allied animals, organs which are homologous are usually also analogous, but in less closely related ones this may or may not be the case. Organs having the same function may be structurally very unlike, for example, the wing of a bird and that of an insect; on the other hand, organs structurally similar may have very different functions, for example, the fore leg of a quadruped and the wing of a bird. This conception of homology lies at the very foundation of all morphological studies; it is the one criterion for determining likeness or unlikeness between organisms. Owen further distinguished between special and general homology, the former signifying fundamental likeness between corresponding parts of different animals, as in the case of the arm of man and the fore limb of a quadruped; while the latter refers to similar parts of the same individual, as in the case of the fore and hind limbs of a quadruped or the right and left sides of the body. Since the term general homology as used by Owen is liable to misinterpretation it would be well to replace it by the expression meristic homology (Bateson), signifying by this term morphological correspondence between parts of the same individual which may be repeated in any relation whatever. Meristic homology would thus include correspondence between parts which are repeated in a series, for example, the vertebræ of the spinal column (serial homology, homodynamy), between parts repeated on the right and left sides of the body, for example, right and left limbs (lateral homology, homotypy) and between parts repeated in any other relations, for example, the fingers of one hand, upper and lower teeth, etc., (vertical homology, homonomy).

Significance of Homology.—To Cuvier and his followers homology meant "conformity to type," to the "archetypal plan" established by the Creator. In the light of evolution, however, homologies are believed to be family or hereditary likenesses due to inheritance from some common ancestor. For this reason special homology might better be called homogeny (Lankester) or homophyly. Contrasted with this are such morphological resemblances as are not due to inheritance, but to similarity of environment acting upon forms of dissimilar descent; such false homology is called homoplasy (Lankester), homomorphy (Gegenbaur) or convergence. It is the task of comparative anatomy to apply to animal structures these criteria of likeness or unlikeness and to distinguish between these various kinds of homology. These various forms of homology are summarized in the following table:

Homology	Special Homology (Homogeny, Homophyly)	
	General Homology (Meristic Homology)	Homodynamy (Serial)
		Homotypy (Lateral)
		Homonomy (Vertical, etc.)
	False Homology (Homoplasy, Homomorphy, Convergence)	

ANATOMY—II. THE MUSCLES OF THE HUMAN BODY.



II. General Structures and Functions of Animals.—Although the differences between the highest and the lowest animals are enormous there are nevertheless certain structures and functions which are practically the same in all animals whatsoever. All animals and plants without exception are composed of cells, while all the functions of living things are the resultants of the aggregate functions of the cells of which they are composed. The cell is thus the universal unit of organic structure and function (Cell Theory of Schleiden and Schwann), and has been defined as a mass of protoplasm enclosing a nucleus (M. Schultze). Protoplasm or living matter is a substance, usually semi-solid, of unknown but undoubtedly very complex chemical composition. It is probably composed of several complex compounds of C, H, O, and N, which do not form a mere mixture but are united in a definite and orderly way. Both the cell body and the nucleus are composed of protoplasm, though of very different quality in the two cases; that which forms the chief mass of the cell, the cell body, is called cytoplasm, while that constituting the nucleus is known as karyoplasm. At least these two kinds of protoplasm are found in every cell and are necessary to the continuance of vital activities. The cytoplasm and karyoplasm are each composed of two or more different substances of visibly different structure, and all these parts are put together in an orderly manner so that they bear definite relations to one another. The cell, therefore, no less certainly than a complex animal, shows organization,, that is, differentiation of unlike parts and integration of these parts into a single and complete whole.

As all organisms are composed of cells, so all living things have certain activities or functions in common. The most important of these are the following: (1) Metabolism, or the transformations of matter and energy within the living thing; this may be subdivided into anabolism, or the change of the matter and energy of food into the matter and energy of protoplasm; and katabolism, or the destructive changes in protoplasm by which the living matter is transformed into less complex substances (secretions, waste products, etc.), while its energy appears in various forms (heat, motion, etc.). Metabolism therefore includes nutrition, growth, waste and repair, movement, secretion, and excretion. (2) Irritability, or the capacity of receiving, transmitting, and responding to stimuli. (3) Reproduction, or the formation of new individuals from the substance of an old one. These general functions are characteristic of every living thing, plant or animal, simple or complex. From them all the functions of the most complex animal are built up, and as they are manifested in some degree by every cell it will be seen that the cell is the unit not only of organic structure but also of organic function.

All animals begin their individual existence as a single cell, but while some remain in this condition throughout life, others by repeated divisions of this initial cell become multicellular; the former constituting the group *Protozoa*, the latter the *Metazoa*. *Protozoa* are animals in which the entire body consists of a single cell, which usually leads an independent existence, though in some cases several may be united into a colony. In some forms the substance of this cell consists of protoplasm showing very little differentiation; in others it is differentiated into many unlike parts, each with its own specific function. The most general differentiation, apart from that of nucleus and cell body, is into a superficial dense layer, the ectoplasm, and a more fluid, granular interior, the endoplasm. Further specializations are shown by the more complex forms in the formation from the ectoplasm of contractile vacuoles, serving as organs of excretion; of thread-like processes, serving as organs of locomotion (*cilia, flagellæ*); of contractile fibres (myophan striations) which act like muscle fibres; of stinging threads (*trichocysts*) which serve as organs of defense; of a mouth and gullet through which food is taken into the interior of the cell, and of a calcareous or silicious skeleton, frequently of great complexity and beauty. All of these structures are differentiations of a single cell; they show how complex such a cell may become, and they indicate that the *Protozoa* are, in the words of one of the old zoologists, «perfect animals.»

In all *Metazoa* the body is composed of many cells differing among themselves in certain respects. These cells have all arisen from a single one, the egg, which by repeated divisions (cleavages) gives rise to a group of connected cells. In typical cases these become arranged in a single layer, forming a hollow sphere, the blastula, which then, by the migration of certain surface cells into the interior, becomes a two-layered sphere; the gastrula, containing a central cavity; the archenteron, or primitive digestive sack, which opens at one place to the exterior by a pore, the blastopore or primitive mouth. The outer layer of the gastrula is called the ectoderm, the inner one the endoderm, while between them a third layer, the mesoderm, usually appears, being derived from one or both of the primary layers. These three layers are known as the germ layers and from them all the organs of the adult metazoan are derived. The ectoderm gives rise to the outer covering of the body, the nervous system, and sense organs; the endoderm to the alimentary canal and its outgrowths, while from the mesoderm arise muscles, skeleton, circulatory, excretory, and reproductive systems.

In all *Metazoa* the ectoderm and endoderm and frequently also the mesoderm consist of cells, flattened, cuboid, or columnar in shape, pressed together side by side into a layer. This simplest and earliest grouping of cells in the metazoan body is called epithelium. From one or more of these epithelial layers cells may escape into the space between the ectoderm and endoderm and there become branched and irregular in shape, forming a loose grouping of cells known as mesenchyme. Epithelium and mesenchyme are the primary tissues of the metazoan body. They are the first formed in the development, and from them all other tissues are derived. The cells of one or both of these primary tissues may undergo further differentiation into contractile or muscle cells and into irritable or nerve cells, while the mesenchyme cells may give rise to non-living cell products such as fibres, spicules, cartilage, bone, and fat. When cells of any one of these groups are united they constitute a tissue, so that in the body of a metazoan we recognize, in addition to epithelial and mesen-

chymatous tissue, muscular, nervous, and sustentacular or connective tissue. Further consideration of these tissues belongs to Histology rather than to Comparative Anatomy. In all *Metazoa* two or more of these tissues may be united to form organs, which are structures of definite shape and individuality having for their purpose the carrying on of specific functions. Finally two or more organs may co-operate in a common function and are then known as an organ system. The principal systems of organs in the metazoan body are the following: (1) Integumentary; (2) Nervous; (3) Motor; (4) Skeletal; (5) Alimentary; (6) Respiratory; (7) Circulatory; (8) Excretory; (9) Reproductive.

III. Fundamental Form of the Metazoan Body.— Although the forms of multicellular animals are extremely varied they may all be referred to a single ground form, the gastrula. From the egg stage to the gastrula all *Metazoa* travel essentially the same road in their development; beyond the gastrula stage they diverge in many directions. The gastrula is therefore the latest developmental stage common to all *Metazoa* and must be taken as the ground form from which they all have been derived. It is typically a double-walled sac surrounding the archenteron or primitive digestive cavity, which opens at one pole to the exterior by the blastopore or primitive mouth. It is radially symmetrical around an axis connecting the oral and aboral poles; this is the primary or gastrular axis. In a few types — for example, sponges, hydroids, jellyfishes — this axis becomes the chief axis of the adult body; such animals constitute the group *Protaxonia*. In others (all bilateral animals) the chief axis of the adult lies almost at right angles to the gastrular axis, and it is derived in large part from one of the secondary axes of the gastrula; these forms are known as *Heteraxonia* or *Bilateralia*. Among the *Protaxonia* the adult form is radially symmetrical and differs but little from the gastrula; this is especially true of the

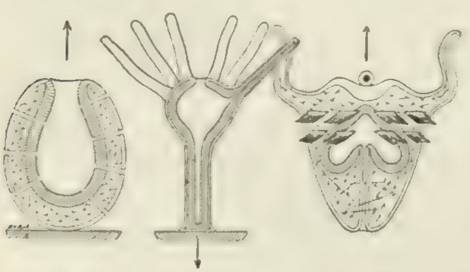


Fig. 1

Fig. 1.— Types of *Protaxonia* (= *Cœlenterata*) (from Hatschek). The chief axis of the gastrula coincides with that of the adult, the apical pole of the gastrula being indicated by the head of the arrow.— *A*, ground form of the *Spongiaria*. *B*, ground form of the *Cnidaria*. *C*, ground form of the *Ctenophora*.

hydroids, some of which are practically gastrulas throughout life which are attached by the aboral pole and with a row of tentacles around the mouth. Among the *Heteraxonia*, on the other hand, the adult shows but little if any resemblance to the gastrula from which it is derived; this is the result not only of the change of axis just mentioned but also of the complication of the gastrular layers and the formation from them of complex organs and parts. In the change of axis it usually happens that the primary axis becomes so bent that the oral and

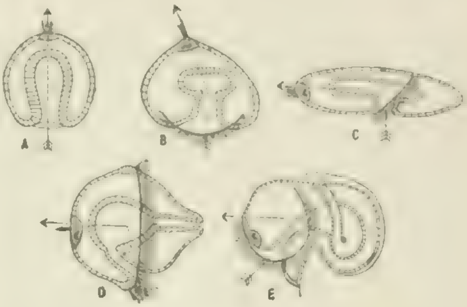


Fig. 2

Fig. 2.— Types of *Heteraxonia* (= *Bilaterata*). The gastrula axis becomes only in part the chief axis of the adult; the apical pole of the gastrula is shifted forward to the anterior end of the adult, while the oral pole of the former lies on the ventral side of the latter or near its anterior end, so that a more or less extensive bending of the gastrular axis occurs; in all cases the brain and eye arise at or near the original apical pole.— *A*, gastrula. *B*, *C*, larva and adult of flatworm. *D*, larva of annelid (trochophore). *E*, larva of gastropod (veliger).

aboral poles approach each other while at the same time one of the secondary axes elongates, becoming the principal axis of the adult, and the body becomes bilaterally symmetrical with reference to a plane passed through this axis and the original primary axis. The apical pole of the gastrula becomes the anterior pole of the adult; since brain and sense organs usually develop at this pole it might also be called the sense pole. The position of the oral pole of the gastrula with reference to the adult axis shows considerable variation in different groups, but among invertebrates it generally lies on the ventral side, while in the case of the vertebrates it is dorsal. The chief axis of the adult connects the anterior and posterior poles and is therefore known as the antero-posterior axis. The side of the body generally directed downward, and at the anterior end of which the mouth usually lies, is ventral, while the opposite side is dorsal and the line connecting these two is the dorso-ventral axis.

There are a few apparent exceptions to the rule that *Heteraxonia* are bilateral forms; some *Heteraxonia* are apparently radially symmetrical (starfish, sea-urchin), while others are asymmetrical (snails, amphioxus, flounders, etc.). The starfishes and sea-urchins are five-rayed animals which were classed by Cuvier among the *Radiata*, but a careful study of the larval as well as the adult form shows that they are really bilateral and that their radial structure has developed from a bilateral form, probably through the influence of peculiar life conditions, such as persistent attachment or fixation to foreign objects. Snails are generally spirally coiled and asymmetrical, but here also the study of their development shows that at an early stage they are bilateral, and even in the adult condi-

tion the head and ventral parts of the body are usually bilateral; the asymmetry of the dorsal part being due, perhaps, to its elongation and the shell formation covering it. In the case of other asymmetrical forms, like amphioxus, flounders, etc., it is certain that we are dealing with modifications of bilaterality due to peculiar conditions of life.

Another modification of the original metazoan ground form, the gastrula, which almost all *Metazoa* show, is due to the formation and development of a middle layer in a space, the blastocœle or primary body cavity, between the ectoderm and the endoderm, namely, the mesoderm. In the lowest *Metazoa* this consists of branched cells (mesenchyme) which are loosely packed together and contain no considerable spaces, or if present these spaces are only parts of the primary body cavity. Among the higher *Metazoa* the middle layer is usually divided into an inner portion lying next to the endoderm and an outer one next to the ectoderm. Between these two layers of mesoderm there remains a space which is the secondary body cavity or cœlom. This is lined by flattened mesoderm cells, the peritoneum, and is usually divided into right and left halves by two longitudinal partitions, the dorsal and ventral mesenteries, one of which lies dorsal to the alimentary canal and the other ventral to it; in some animals one or both of these may be destroyed. In segmented animals the cœlom may be further divided into a series of chambers by transverse partitions, the dissepiments. The excretory and sexual organs are developed in large part from the walls of the cœlom and project into its cavity. The portion of the cœlom surrounding the heart is usually separated from the remainder of this cavity and is called the pericardium; while in the highest vertebrates (mammals) the anterior portion of the cœlom which contains the lungs is separated by the diaphragm from the posterior part containing the abdominal viscera.

A further complication of the metazoan body is introduced by the repetition of the principal organs of the body in a series, one behind the other; such repetition is known as metameric segmentation, and each segment of the body is called a metamere or somite. Many of the higher *Metazoa* (annelids, arthropods, vertebrates) show this form of segmentation. In the simplest cases each of these somites has its own section of the cœlom and its own sensory, nervous, muscular, alimentary, respiratory, excretory, and sexual organs, and each may bear a pair of limbs or locomotor organs. Each somite, in short, contains all of the important organs and may properly be called a little body (somite). In more highly organized segmented animals the various segments are no longer alike (homonomous), but show physiological divisions of labor, some being differentiated for one function and some for another (heteronomous). In this way some of the organs named above disappear in certain segments while others become greatly enlarged or modified. Finally this specialization of the somites is carried one step farther in higher arthropods and in vertebrates in which we have an intimate fusion of metameres and coalescence of organs in certain regions such as to completely mask the fundamental segmentation. This is especially true of the vertebrates, the lower forms of which group show segmentation of the axial skeleton (vertebræ and ribs) and attached muscles, of the nerves, of the gills and their blood vessels, and of the excretory and sexual organs; while in the higher vertebrates (reptiles, birds, and mammals) segmentation is limited in the adult to the axial skeleton, muscles, and nerves. The fusion of somites is most pronounced at the anterior end of the body; the head of insects contains three or four somites, while the vertebrate head is composed of not fewer than nine. Among arthropods the section of the body immediately behind the head and known as the thorax is composed of a number of fused somites, while in the posterior section of the body, the abdomen, the somites do not usually coalesce. Primitively the limbs are all alike and a pair is borne on each somite; however in higher annelids and arthropods they disappear entirely from certain somites and in others undergo great modifications of structure to fit them for particular functions. In the case of vertebrates they are limited to but two pairs, and it is probable that these are derived from a continuous lateral fin by the suppression of intervening portions. The great modifications and complications which have here been briefly sketched lead far from the simple form of the gastrula, and yet comparative anatomy and embryology show that the gastrula is the ground form of all *Metazoa* and they indicate in many cases the steps by which these most complex parts have arisen.

IV. Classification.—Although there is much diversity of opinion as to the number of types

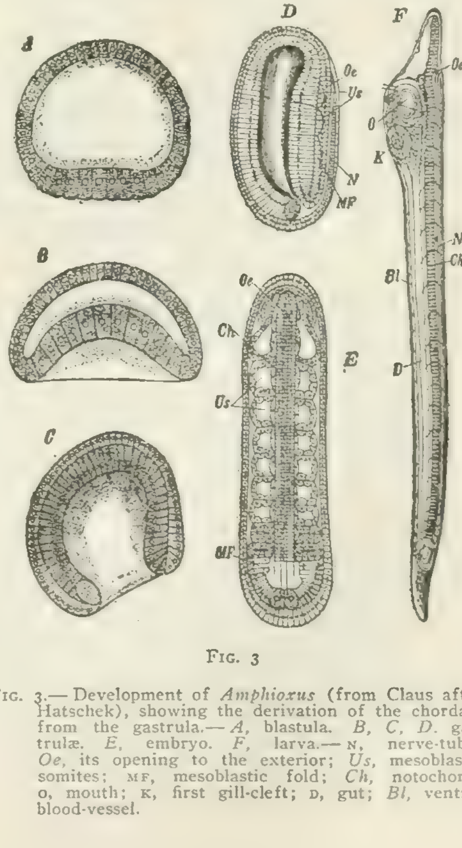


Fig. 3

Fig. 3.— Development of *Amphioxus* (from Claus after Hatschek), showing the derivation of the chordate from the gastrula.— *A*, blastula. *B*, *C*, *D*. gastrulæ. *E*, embryo. *F*, larva.— N, nerve-tube; *Oe*, its opening to the exterior; *Us*, mesoblastic somites; MF, mesoblastic fold; *Ch*, notochord; O, mouth; K, first gill-cleft; D, gut; *Bl*, ventral blood-vessel.

or phyla in the animal kingdom it is certain that there are more than the four recognized by Cuvier, the number being probably not less than ten or twelve. The present tendency

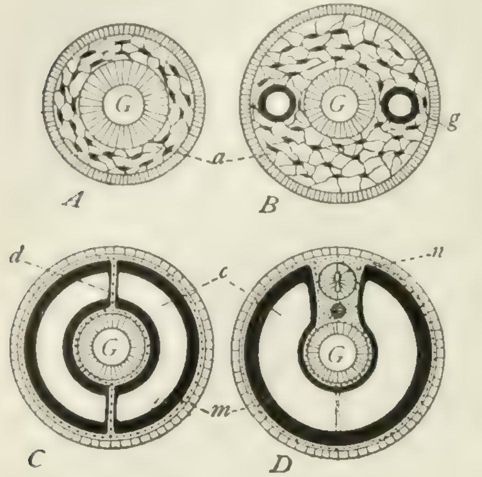


FIG. 4

FIG. 4.—Diagrams of body layers and cavities in *A*, cœlenterates; *B*, flatworms; *C*, annelids; *D*, vertebrates.—G, gastric cavity; *g*, cavity of gonad; *a*, primary body cavity (blastocœle) filled with branched cells (mesenchyme); *c*, secondary body cavity (cœlom); *d*, dorsal mesentery; *m*, mesenchyme filling space of original primary body cavity; *n*, nerve-tube.

among zoologists is to increase this number rather than to reduce it; but the absolute separateness and independence of these types is not now generally maintained. Many of them have important characters in common, and while sufficiently distinct to mark the primary subdivisions of the animal kingdom are yet evidently related to one another. The primary divisions or phyla which are now most generally recog-

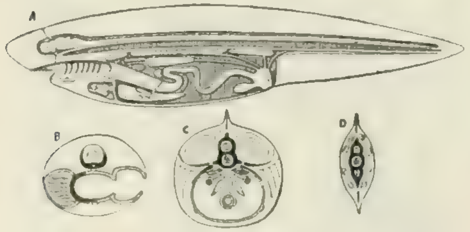


FIG. 5

FIG. 5.—Diagrammatic sections of an ideal vertebrate (after Parker and Haswell).—*A*, sagittal section showing the brain and spinal cord on the dorsal side of the notochord, and the alimentary canal and viscera on the ventral side of it. *B*, transverse section of the head, showing a gill-arch and filaments on the left and a gill-cleft on the right. *C*, transverse section of the trunk, showing the gut, the genital glands, and the excretory organs in the body cavity. *D*, transverse section of the tail.

nized are the following: (1) *Protozoa*, (2) *Spongiaria*, (3) *Cnidaria*, (4) *Ctenophora*, (5) *Platyhelminthes*, (6) *Nemathelminthes*, (7) *Rotifera*, (8) *Chætognatha*, (9) *Annelida*, (10) *Arthropoda*, (11) *Molluscoida*, (12) *Mollusca*, (13) *Echinodermata*, (14) *Chordata*. Some forms cannot with certainty be assigned to any of these groups, and new phyla may need to be established for them; on the other hand future work may show that two or more of the groups named may be combined under a single phylum. The value of these phyla so far as the number and variety of animals included in them is concerned is very unequal, some of them including but a single order and but a few genera, while others include many classes, orders, and genera; in fact, about one half as many species are known in a single order of the class *Insecta* as in all the remainder of the animal kingdom put together. A tabular classification of each of these phyla and of the classes into which it is subdivided is given on the three following pages:

V. ORGAN SYSTEMS.—When two or more organs are associated in carrying on a common function they constitute an organ system. Those systems most widely represented among animals, and therefore the most important, are those concerned with the general functions of all animals, namely, metabolism, reproduction, and irritability. The first of these consists of several distinct though related functions, each with its own system of organs; accordingly we recognize the following systems: (1) digestive, (2) respiratory, (3) circulatory, (4) excretory, (5) motor, (6) reproductive, (7) nervous, (8) sensory; to these may be added those less important systems which serve for protection and support, namely, (9) integumentary, (10) skeletal. These organ systems will now be compared in broad outlines, with a view to showing their relationships in the leading phyla of the *Metazoa*. For the sake of convenience the integumentary, skeletal, and motor systems will here be considered before any of the others.

1. *Integumentary System.*—In all animals the outer covering of the body consists of a layer of epithelial cells, the ectoderm. Beneath this layer a basement membrane is present, which in some animals is thick and serves for protection and support (*Cnidaria*, *Platoda*). This epithelium is frequently ciliated and it always contains gland and sensory cells and in addition may contain nerve and muscle cells as well as stinging cells (*Cnidaria*). In some animals the epithelium, which in these cases is called hypodermis, secretes on its outer surface a cuticular covering which may be a thin and flexible membrane or cuticle (hydroids, trematodes, cestodes, annelids, rotifers), or it may be thick and flexible (nemathelminths) or dense and inflexible except at the joints (arthropods). In other cases the epithelium secretes skeletal structures in certain regions only, thus giving rise to calcareous shells (corals, mollusks, brachiopods). In arthropods this epidermal secretion is particularly dense and tough and is known as chitin; it may become calcified in certain portions. In mollusks the superficial epithelium remains naked except in a certain region, the embryonic shell-gland, where it first secretes a cuticular covering and then forms beneath this a dense calcareous layer, the shell; at the margins of the shell-gland (mantle edges) the secretion of these layers continues throughout life.

CHIEF SUBDIVISIONS OF THE ANIMAL KINGDOM.

A. PROTOZOA: One-celled animals without gastric cavity, germ layers, or tissues.

Class 1. *Rhizopoda:* With streaming protoplasmic processes (pseudopodia). Example, *Amœba.*

Class 2. *Flagellata:* With one or two vibratile protoplasmic processes (flagellæ). Example, *Monad.*

Class 3. *Ciliata:* With many vibratile protoplasmic threads (cilia) Example, *Infusoria.*

Class 4. *Sporozoa:* Parasites without mouth or organs of locomotion. Example, *Gregarina.*

B. METAZOA: Many-celled animals with gastric cavity, germ layers, and tissues.

A. PROTAXONIA (=*Cœlenterata*): *Metazoa* with gastrula-like body, persistent gastrular axis, and radial symmetry.

I. SPONGIARIA: Fixed aquatic animals with numerous pores in body wall through which water is drawn into the gastric cavity and thence expelled through a large opening, the osculum. Complicated colonies are formed by incomplete budding.

Order (1). Calcarea: With skeleton formed of calcareous spicules. Example, calcareous sponge.

Order (2). Non-calcareous: With silicious, fibrous, or gelatinous skeleton. Example, commercial sponge.

II. CNIDARIA: Aquatic animals either attached (polyps) or free-swimming (*Medusæ*) with stinging cells (cnidæ). By incomplete budding the polyps may give rise to plant-like colonies (hydroids), or by complete budding to jellyfishes (*Medusæ*).

Class 1. *Hydrozoa:* Gastric cavity without septa and without ectodermal œsophagus.

Order (1). Hydromedusæ: Usually with alternation of hydroid (asexual) and medusoid (sexual) generations. Examples, hydroids, small jellyfishes.

Order (2). Siphonophora: Floating colonies of many polymorphic zooids. Example, Portuguese man-of-war.

Class 2. *Scyphozoa:* With radial septa in gastric cavity and with ectodermal œsophagus.

Order (1). Scyphomedusæ: The solitary polyp divides into a series of jellyfishes with notched margins. Example, large jellyfishes.

Order (2). Anthozoa: The polyps divide but do not form jellyfishes. Examples, sea-anemones, corals.

III. CTENOPHORA: Two-rayed radiates with sense organ at apical pole of gastrula, with mouth and ectodermal œsophagus at opposite pole and with eight meridional rows of vibratile plates which serve as locomotor organs; without stinging cells. Example, the Venus girdle.

B. HETERAXONIA (=*Bilaterata*): Animals in which the chief axis of the adult body is not that of the gastrula; symmetry bilateral.

IV. PLATYHELMINTHES: Flatworms with mouth usually on ventral surface and with apical (sensory) pole of gastrula near anterior end of body; primary body cavity filled with mesenchyme, no true cœlom.

i. PLATODA: Gastric cavity, when present, with but one opening to the exterior, the mouth.

Class 1. *Turbellaria:* Free living forms; body covered by cilia. Example, planarians.

Class 2. *Trematoda:* Parasites without coat of cilia but with external cuticle; with suckers for attachment to host. Example, flukes.

Class 3. *Cestoda:* Parasites without mouth or alimentary canal; with external cuticle, but without cilia; usually incompletely divided into segments (proglottides). Example, tapeworms.

ii. NEMERTINEA: Free living worms with external covering of cilia; with mouth, alimentary canal, and anus; with protrusible proboscis at anterior end of body. Example, *Cerebratulus.*

V. NEMATHELMINTHES: Round worms, mostly parasitic, with long, unsegmented bodies covered by a dense cuticle; with primary body cavity; without cilia.

i. NEMATODA: Thread worms without mesenteries or peritoneum; with nerve ring around œsophagus and dorsal and ventral nerve trunks Examples, pinworms, vinegar-eels.

ii. GORDIACEA: Hair worms parasitic during part of life; with mesenteries and peritoneum; with nerve ring and ventral nerve trunk. Example, horsehair worms.

iii. ACANTHOCEPHALA: Internal parasites without alimentary canal; with proboscis and hooks for attachment to host. Example, *Echinorhynchus.*

VI. ROTIFERA: Wheel animalcules with body divisible into head (trochal disk), trunk, and tail (foot); with wheel or crown of cilia around head; with primary body cavity, and with grinding stomach (mastax). Example, wheel animalcules.

VII. CHÆTOGNATHA: Small marine worms with three body segments, namely, head, trunk, and tail; with horizontal fins around tail and on sides of trunk; with bristles (chætæ) on sides of mouth; with true cœlom (secondary body cavity). Example, arrow-worms.

VIII. ANNELIDA: Ringed worms with segmented bodies and true cœlom; the segments (somites) are typically similar (homonomous) and each encloses a section of the cœlom and of the vascular, excretory, and nervous systems.

Class 1. *Chætopoda:* Worms with bristle-like appendages (chætæ), which usually serve as organs of locomotion, on every somite. Example, earthworm.

Class 2. *Gephyrea:* Marine worms with few traces of segmentation; with crown of tentacle around mouth and with U-shaped alimentary canal, the anus opening near the mouth.

Class 3. *Hirudinea:* Worms with flattened bodies and rudimentary cœlom, without chætæ, but with anterior and posterior suckers. Example, leeches.

IX. ARTHROPODA: Animals with jointed bodies and legs; without cilia, but with the entire surface of the body covered by a coat of dense substance, chitin.

i. BRANCHIATA: Aquatic animals with gills.

Class 1. *Crustacea:* With two pairs of antennæ (feelers) and usually with gills borne on the legs. Examples, lobster, crab.

ii. TRACHEATA: Land animals with internal respiratory cavities (tracheæ, lung books).

Class 1. *Onychophora:* Worm-like animals with numerous short legs. Example, *Peripatus.*

Class 2. *Myriopoda:* Animals with head and many-jointed body, every segment bearing one or two pairs of legs. Example, centipedes.

Class 3. *Insecta:* Animals with body divisible into head, thorax, and abdomen; with four pairs of appendages on head, three pairs of walking legs on thorax, but without appendages on abdomen.

Class 4. *Arachnida:* Body divisible into cephalo-thorax and abdomen; with six pairs of appendages on former, but none on latter. Examples, scorpions, spiders.

X. MOLLUSCOIDA: Unsegmented animals, usually stalked and attached, living singly or in colonies; with a crown of ciliated tentacles around the mouth; generally with U-shaped alimentary canal and with anus opening near mouth.

Class 1. *Phoronida:* Single, stalked animals with body cavity partially divided into three portions. Example, *Phoronis.*

Class 2. *Brachiopoda:* Single animals with calcareous shell consisting of dorsal and ventral valves. Example, brachiopods.

Class 3. *Polyzoa:* Stalked animals which usually give rise to colonies by incomplete budding.

XI. MOLLUSCA: Unsegmented animals with reduced cœlom; differing greatly in form, but usually having a head, with tentacles and eyes; with a rasping organ (the lingual ribbon or radula) in the mouth; with dorsal visceral sac containing most of the viscera; with a free fold of the body wall, the mantle, which usually secretes a shell, and with a ventral muscular foot.

Class 1. *Pelecypoda:* Bivalve mollusks without head or lingual ribbon; with filiform or plate-like gills. Examples, clams, oysters.

Class 2. *Amphineura:* Bilateral animals with paired nerve trunks. Example, chitons.

Class 3. *Gasteropoda:* Unsymmetrical mollusks, with univalve shell, usually spirally coiled. Example, snails.

Class 4. *Scaphopoda:* Small mollusks with tubular, uncoiled shells. Example, *Dentalium*.

Class 5. *Cephalopoda:* Active, predaceous mollusks with unpaired mantle and shell and with eight or ten arms which bear suckers. Example, squid octopus.

XII. ECHINODERMATA: Five-rayed marine animals, with dermal skeleton of spines or plate; with ambulacral system of tubes which are filled with sea-water.

Class 1. *Holothuroidea:* Soft, worm-like animals with reduced skeleton; the mouth surrounded by retractile tentacles. Example, sea-cucumbers.

Class 2. *Echinoidea:* Spherical or oval forms with complete armor of dermal plates. Example, sea-urchins.

Class 3. *Asteroidea:* With five arms radiating from a central disk; with open ambulacral grooves on the oral side of arms. Example, starfishes.

Class 4. *Ophiuroidea:* With arms and central disk, but with closed ambulacral grooves. Example, brittle stars.

Class 5. *Crinoidea:* The cup-shaped body bearing many branching arms is usually attached by a stem. Example, stone-lilies.

XIII. CHORDATA: Bilateral, segmented animals with an axial skeleton, the notochord, on the dorsal side of which is the tubular nervous system and on the ventral side the alimentary canal; with gill slits opening laterally through the walls of the pharynx.

i. HEMICHORDA: Worm-like animals which burrow in the sand. Example, *Balanoglossus*.

ii. UROCHORDA: Sac-like animals enclosed in thick tunic (*Tunicata*) in which are inhalent and exhalent openings. Example, sea-squirts.

iii. CEPHALOCHORDA: Fish-like animals, pointed at both ends, which burrow in the sand; without skull or brain (*Acrania*). Example, *Amphioxus*.

iv. VERTEBRATA: Chordates with skull and brain; with relatively few gill slits; the notochord serves as a foundation for the vertebral column; usually with two pairs of locomotor appendages.

(a). **Anamnia:** Aquatic vertebrates with functional gills; without embryonic membranes.

Class 1. *Cyclostomata:* Eel-like fishes without jaws, but with circular sucking mouths; with single olfactory organ; without paired fins. Example, lamprey.

Class 2. *Pisces:* Cartilaginous and bony fishes with movable jaws, persistent gill clefts, paired and median fins, and dermal exoskeleton of scales. Examples, sharks, fishes.

Class 3. *Amphibia:* Vertebrates with pentadactyl limbs with gills and gill clefts in larval life which may be lost in the adult. Examples, frogs, newts.

(b). **Amniota:** Air-breathing vertebrates in which the gills are never functional; the embryo is always surrounded by embryonic membranes (amnion and allantois).

Class 4. *Reptilia:* Body covered by horny scales or plates; heart usually three-chambered; one occipital condyle. Examples, snakes, alligators.

Class 5. *Aves:* Birds with body covered with feathers and usually fitted for flight; with four-chambered heart and single occipital condyle. Examples, sparrow, pigeon.

Class 6. *Mammalia:* Animals with the body covered with hair; with mammary glands for suckling the young; with four-chambered heart and with two occipital condyles. Examples, dog, horse, man.

In reptiles, birds, and mammals the superficial epithelium (epidermis) becomes many layers thick, and the outer layers of cells die and are transformed into horny or cuticular substance; an adaptation to life out of water. In these three classes of vertebrates there are also a number of characteristic epidermal outgrowths: in reptiles these take the form of horny scales or plates; in birds they appear as feathers, which are only modified scales; and in mammals as hair, while nails or claws are formed from the epidermis in all of these classes. In the mammals there are also epidermal ingrowths which give rise to various types of glands, such as sweat, oil, wax, and milk glands, all of which are epidermal in origin.

Beneath the surface epithelium, which is always ectodermal in origin, there is in many animals a fibrous or connective tissue layer known as the dermis or corium. This layer is especially well developed among echinoderms and vertebrates, in both of which it may give rise to skeletal spicules or plates, thus forming a dermal exoskeleton. Among the vertebrates this is especially well developed in the fishes, the scales which cover the body being of dermal origin; in some cases these dermal scales are covered by enamel which is derived from the epidermis. The same is also true of the teeth of vertebrates; the inner portion or dentine is of dermal origin, while the enamel comes from the epidermis; teeth are in fact only modified scales.

2. *Skeleton.*— An internal skeleton, not the product of the integument, is present in relatively few invertebrates, but is found in all vertebrates. Such a skeleton is found in sponges in the form of calcareous, silicious, or horny spicules; in cnidarians and ctenophores as supporting jelly; in many invertebrates as a system of connective tissue cells and fibres; in cephalopods and certain arthropods as cartilages surrounding the central nervous system. On the other hand the possession of a primitive axial skeleton, the notochord, is one of the chief characteristics of the *Chordata;* in addition to this there are generally present in this phylum many other skeletal elements which are usually cartilaginous or bony. In all true vertebrates the notochord becomes surrounded by cartilage, and the whole is then constricted into a series of segments, the centra of the vertebræ; from these centra cartilaginous arches grow dorsally around the spinal cord, while other skeletal arches, the ribs, surround the trunk and become connected with the vertebral column; finally the ribs may be united ventrally, thus forming the sternum: these parts constitute the axial skeleton. In addition there is the skeleton of the head (the skull) and that of the limbs (the appendicular skeleton). In the lower vertebrates and in the embryos of all higher forms the skull consists of a cartilaginous cranium partially surrounding the brain, and of paired cartilaginous rods forming the skeleton of the jaws and gill-arches. In higher vertebrates these cartilaginous elements undergo ossification, and in addition dermal bones are formed which partially overlie this cartilaginous basis. The appendicular skeleton consists of the two limb-girdles partially enclosing the trunk on the ventral side, the pectoral and pelvic arches, and of the skeleton of the limbs themselves. In the fishes the arches and limbs are peculiar and it is difficult to homologize their skeletal parts with those of higher forms; in all vertebrates above the fishes, however, the relations of these parts are similar and their homologies not difficult to determine.

3. *Motor System.*— All animals at some time in their lives have the power of locomotion, though in some cases this is lost before adult life is reached and the animal becomes fixed like a plant (hydroids, sponges, crinoids, molluscoids, and many parasites). However, in all these cases certain parts of the body preserve the power of movement, though the animal as a whole is incapable of locomotion. Animal movement is of three fundamental types: amœboid, ciliary, and muscular. See MUSCLES.

(1) Amœboid movement is manifested especially by free cells and exhibits a streaming of semi-fluid protoplasm: it is typically illustrated by the proteus animalcule *Amœba.* In this protozoan small lobes or pseudopodia may appear anywhere on the body, and into one or more of these the endoplasm, with all that it contains, may be seen to stream, at the same time being withdrawn from other lobes. This flowing may continue for some time in a given direction, the outflow of protoplasm at one end of the body being compensated for by the inflow at the other end, thus producing an actively progressive movement. The mechanism of this movement is obscure, but in some cases it seems to be associated with temporary inequalities in the tension of the surface of the cell; at points where the surface tension is reduced an outflow of protoplasm occurs, forming a lobe or pseudopod, into which protoplasm from the main body continues to flow so long as the surface tension is least in this direction. Usually several points of reduced tension exist at the same time on the surface of an amœboid cell, so that several lobes or pseudopodia are found radiating from a common centre. In other cases it is, perhaps, due to the general contractility of protoplasm, local contraction in one part of a cell causing an outflow in another part.

(2) Ciliary movement consists in the rhythmical beating of innumerable small protoplasmic threads (cilia) which project from the free surfaces of certain cells and which act somewhat like oars. Among one-celled organisms the entire cell may be covered by these cilia; in all multicellular animals they are limited to the free borders of certain epithelial cells. The beating of a cilium includes two movements, — the stroke, which is rapid and by which the cilium is sharply bent in one direction, and the recovery of the original position, which is relatively slow and weak. It is probable that the cause of this beating is the unequal contraction of the protoplasm on different sides of a cilium, by which it is bent first in one direction and then in the other. All the cilia covering a free surface beat in unison, the stroke being in one direction, and the movement is so timed that beginning at one end of a ciliated tract it seems to pass in a wave-like movement to the other end.

(3) Muscular movement, the principal type of motion in higher animals, is caused by the contraction in one direction of a muscle fibre consisting of a kind of protoplasm especially differentiated for this purpose. During the contraction or expansion of a muscle there is no change in its volume, the shortening of a fibre in one

axis being compensated for by its expansion at right angles to that axis. Such a change in the shape of a fibre could be produced only by a change in the shape of the particles of which it is composed or by a change in their relative positions. The latter is probably the real cause of muscular contractility.

All of these types of movement are found in certain *Protozoa* and in many *Metazoa*. Amœboid movements are, however, usually restricted to free cells without membranes or dense cortical layers of protoplasm, such as certain egg cells, embryonic cells, endoderm cells, excretory, pigment, and lymph cells of various *Metazoa;* in no case is this type effective in the movement of large bodies. In the larvæ of all phyla, except the nemathelminthes and arthropods, locomotion is brought about, at least in part, by cilia, and even among the adult forms of many lower metazoans this is the principal type of locomotion (ctenophores, turbellarians, nemertines, rotifers). Among the nemathelminths and arthropods cilia are entirely lacking throughout the whole life cycle. Among large animals locomotion is effected entirely by muscular contractility, while cilia are limited to certain regions where by their beating they produce currents. Muscle fibres are found in all *Metazoa* with the possible exception of sponges; they are of two kinds, striped and non-striped or smooth; the latter are of very wide distribution throughout the *Metazoa*, the former are limited to a few phyla (mollusks, arthropods, chordates). Smooth muscle is contractile to a much greater extent than striped muscle, but is much slower in action. The muscular system may consist of isolated fibres such as are found in many cnidarians, platodes, and rotifers, or these fibres may be united into bundles or sheets as is the case in most higher animals; these groups of muscles show many differences and can be compared only in a general way. In general the arrangement of the body muscles depends upon the presence or absence of a skeleton. Animals which have no skeleton usually have the body musculature arranged in the form of two coats: an outer layer of circular fibres and an inner of longitudinal ones, while the intestinal musculature is also arranged in two coats, the outer (next the cœlom) longitudinal and the inner circular. If an exoskeleton is present, as in arthropods, these muscular layers of the body wall are broken up into bundles which become attached to the skeleton; if an endoskeleton is present, as in vertebrates, the muscles become attached to the bones, which serve as levers, and thus the muscles come to lie at a deep level. The locomotor apparatus of echinoderms is unique, consisting of a great number of tube feet, which are hollow muscular tubes, closed at the end by a sucking disk. The cavity of each tube is connected with the water vascular (ambulacral) system within the body, from which water can be forced into the tube feet. In this way they are protruded until the sucking disk touches and becomes attached to some object; then by contraction of the muscles of the foot the water is forced back into the water system, and by simultaneous action of many of these feet the body is slowly warped along.

4. *Digestive System.*— With the exception of a few internal parasites which absorb their food in a digested condition from the bodies of their hosts, some form of digestive system is present in all animals.

Digestion is the process of rendering insoluble foods soluble. One of the distinguishing characteristics of animals is that they, unlike plants, take in solid food (much of which is in an insoluble condition) through a mouth opening (ingestion), and that by the process of digestion some of this insoluble food is rendered soluble and hence capable of diffusing to all parts of the organism, where by a mysterious process known as assimilation some of it is built up into the substance of the protoplasm itself. After the substances rendered soluble by digestion have been removed from the food the indigestible remnants are cast out of the body in solid form (egestion). Among the *Protozoa* digestion occurs within the body of a single cell, that is, it is intracellular. The same is true of the sponges, in which the food, consisting of microscopic animals or plants, is taken in by certain epithelial cells lining the cavities of the the sponge and by them passed over to other cells and tissues by which the food particles are ingested, digested, and assimilated. In all animals above the sponges intracellular digestion is limited to the endoderm cells and to certain free cells, such as white blood corpuscles (leucocytes) and it is of decreasing importance as one ascends the scale. In all animals except the lowest, digestion occurs principally in a digestive cavity surrounded by cells which pour their secretions into the cavity. By the action of these secretions certain insoluble food substances are transformed into soluble ones. This digestive cavity is in all cases derived from the archenteron or primitive digestive cavity of the gastrula and in the simplest cases is little more than a sac whose walls may be folded into ridges or septa, thus enlarging the digestive surface (*Anthozoa*), or they may be extended to form tubular canals, by means of which the digested food is distributed to all parts of the animal (*Scyphozoa, Ctenophora, Turbellaria*). In all *Cnidaria* except the lowest class, and in all animals above the *Cnidaria*, the ectoderm surrounding the mouth is folded in at the mouth opening, thus forming an ectodermal tube, or œsophagus, which opens at the inner end into the gastric cavity. Among chordates this ectodermal invagination forms only the mouth cavity, the œsophagus being derived from the endoderm. In all *Cnidaria, Ctenophora*, and *Platoda* there is but one opening into the gastric cavity, the mouth, and through this single opening food is taken in and undigested remnants cast out. In the *Nemertinea*, and with a few exceptions in all higher animals, there is a second opening into the gastric cavity, namely, the anus, through which the ejecta pass. The anus is formed by an infolding of the ectoderm which meets and fuses with a portion of the gastric wall; this terminal ectodermal portion of the digestive tract is the hind gut. With the formation of an anus the digestive tract becomes tubular, with mouth at one end and anus at the other, and the entire canal is divisible into three portions, an ectodermal œsophagus or fore gut, an endodermal mid gut and an ectodermal hind gut. The relative development of these three portions differs much in different phyla; for example, among chordates the fore gut is limited to the mouth cavity and the hind gut to an in-

significant terminal portion of the intestine, while the mid gut gives rise to all the intervening portions of the digestive tract. Among arthropods, on the other hand, the mid gut is limited to an extremely small portion of the digestive tube between the stomach and intestine, while all the remaining portions are derived from the fore and hind guts. In the higher animals the fore and mid guts may be subdivided into mouth cavity, pharynx, œsophagus, stomach, and intestine and in some cases these portions may be further subdivided, as, for example, in birds, where the œsophagus gives rise to an enlargement, the crop, the stomach is divisible into a glandular stomach and a grinding stomach or gizzard, and the intestine consists of two portions, the small and the large intestine. Finally into a portion of the hind gut the excretory and sexual ducts as well as the intestine may open, in which case this common chamber is called the cloaca. Various portions of the fore gut may be armed with teeth, usually of a horny character among invertebrates, and the pharynx may be protrusible. The digestive and absorptive surfaces of the mid gut may be increased in three different ways, either (1) by an increase in length, in which case it becomes folded or coiled, or (2) by folds which project into the canal, or (3) by diverticula, that is, blind sacs or tubes, which open out from the canal; in many higher forms all of these methods coexist in the same individual. The extent of the digestive surface depends primarily upon the character of the food; if the latter is highly nutritious the digestive surfaces are much smaller than where it is poor in nutrition. In carnivorous mammals, for example, the alimentary tract is from four to five times the length of the body, whereas in certain herbivora it may be from 20 to 30 times the length of the body. In the simplest *Metazoa* it is probable that all the cells lining the digestive cavity are alike and that they all secrete the same digestive fluids; in more complex animals the cells differ in structure and function in different portions of the tract. By a specialization of the diverticula or blind tubes opening out from the canal, large digestive glands are formed which pour particular digestive secretion into the alimentary canal. The most generally distributed of all these are the salivary glands, opening into the fore gut, and the liver and pancreas (or where both are united, as often happens among the invertebrates, the hepatopancreas), which open into the mid gut. In all of the lower invertebrates except the roundworms the food is moved about in the alimentary tract by means of cilia or by general contractions of the body. In all higher forms the contraction of muscle fibres surrounding the canal play an important part in this movement, though cilia may also be present. In the chordates both longitudinal and circular muscles surround the canal and by their rhythmical contractions produce a wave-like contraction of the canal (*peristalsis*), which passes along the canal from mouth to anus.

5. *Respiratory System.*— Respiration consists in the exchange of gases between the body and the medium which surrounds it. The gas given off from the body is principally carbon dioxid, one of the products of combustion within the body, while that which must be supplied to it is oxygen. Since oxidation is the one essential feature of destructive metabolism which occurs in all living matter, it follows that respiration is a universal function among organisms. Among small and simple animals this exchange of gases takes place directly between the living cells and the surrounding medium and occurs all over the surface of the body. In more complex forms with body fluids the exchange takes place between the tissues and the fluid (internal respiration) and then between the fluid and the surrounding medium (external respiration). This exchange may take place through the general integument of the body without the aid of any specific organs, as is the case in all small animals and in many larger ones,— for example, flatworms, roundworms, rotifers, small annelids, and even some vertebrates, such as the lungless salamanders. However, in most animals of any considerable size, special organs exist to facilitate this exchange. In such as dwell in water vascular processes are present which serve to bring the blood into close relation with the water. These processes, which are called branchiæ or gills, are covered by a thin epithelium through which an interchange of the gases contained in the blood and in the water can readily take place. To facilitate this interchange the gills are usually much folded or branched so as to afford a large

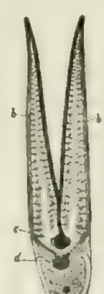


FIG. 6.

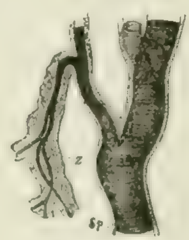


FIG. 7.

FIG. 9

FIG. 8

FIG. 6.— Section through the gill-arch and plates of a bony fish (from Claus).— *b*, gill-plates with capillaries; *c*, afferent vessel with venous blood; *d*, efferent vessel with arterial blood; *a*, skeleton of arch.

FIG. 7.— Part of a tracheal stem and branches of an insect (from Claus).— *Z*, cellular outer wall. *Sp*, cuticular inner wall with spiral fibre.

FIG. 8.— Tracheal system of a fly larva (from Claus). — *Tr*, longitudinal stem of right side. *St'*, *St''*, anterior and posterior stigmata. *Mh*, mouth parts.

FIG. 9.— Lateral view of grasshopper (*Acridium*).— *St*, stigmata. *T*, tympanal organ (from Claus).

surface, and they are frequently covered by cilia which serve to keep the water in motion, while at the same time the blood is circulated through them. The most primitive type of gill is that of a simple ciliated tentacle, which may also serve other functions, such as is found among the *Molluscoida* and some *Mollusca;* such gills may become branched or plume-like or may fuse together into plates (*Lamellibranchia*). Gills are situated on those parts of the body where

they will be most exposed to fresh water, and occur in the most extraordinarily different positions in different phyla; thus they may be found on the limbs (*Crustaceæ*, some annelids), on or around the head (sedentary annelids, molluscoids), along the sides of the body (primitive mollusks), on the lateral walls of the pharynx (chordates), or as outgrowths of the hind gut (holothurians). Homology being «correspondence in the relative position and connection of parts,» there can of course be no homology between structures occurring in such diverse positions, and yet within a given phylum they may be homologous and of high morphological value (for example, chordates). Among the chordates a series of gill-clefts opens right and left through the walls of the pharynx, and in the lower classes of the phylum the gills are found as highly vascular plates or tufts on the outer sides of the arches separating these clefts; water is taken in through the mouth and then forced out through the gill-clefts and thus over the gills. In the higher classes of the phylum (reptiles, birds, and mammals), the gill-clefts are present during embryonic life, though at no time in their entire life-history do these animals have gills and respire water. The constancy of gill-clefts among vertebrates gives this character a high value in determining the affinities of such doubtful forms as *Balanoglossus*, *Cephalodiscus*, and *Tunicata*.

In animals which do not dwell in water and in some few which do (insect larvæ, lung fishes, etc.), certain infolded portions of the body occur into which air is drawn and from which it is again expelled. Among invertebrates these infolded portions are generally derived from the skin; among vertebrates from a portion of the alimentary canal, the pharynx. In the case of insects and allied forms (*Tracheata*) these infolded portions have the form of much-branched tubes, the tracheæ, which reach to all parts of the body, the terminal twigs of the tracheal system of tubes being found in connection with almost every bit of tissue in the body. These tracheæ open to the exterior through closeable pores, the stigmata, situated on the sides of the body; air is taken in through these pores and by means of the tracheal tubes penetrates to all parts of the body, the exchange of gases taking place directly between the tissues and the tracheæ. Among the vertebrates the lungs are an evaginated portion of the pharynx, which in most fishes is a hydrostatic apparatus, the swim-bladder, but which in the lung fishes (*Dipnoi*) becomes highly vascular and may serve as a lung. In all higher vertebrates this sac is paired, and its walls, which in the lower classes are relatively simple, become much infolded and very richly supplied with blood vessels. The exchange of gases here takes place between the blood and the air within the lung, and in most vertebrates the oxygen-carrying capacity of the blood is increased by the presence of hæmoglobin (the coloring matter of red blood corpuscles) which enters into a loose chemical combination with the oxygen.

6. *Circulatory System.*— The physiological significance of the circulation of fluids within the body is the distribution of nutriment and in some cases oxygen to all the parts. In the simplest *Metazoa* (*Cnidaria*, *Ctenophora*) there is no need of a special circulatory apparatus other than that which is furnished by the gastric cavity itself; this may branch and extend to various parts of the body or hydroid colony, thus forming a gastro-vascular system, through which the distribution of nutriment takes place; the branched gastric cavity of certain turbellarians serves also a similar function. Circulation of body fluids also occurs in many lower animals without the aid of any special circulatory apparatus; in such cases lymph, containing the products of digestion, is distributed through all the intercellular spaces in the primary body cavity, and by the contractions of the general musculature of the body it is kept in irregular movement. With the single exception of the nemerteans a blood vascular system is found only among animals with a secondary body cavity or true cœlom and is lacking even in some of these, particularly such as are quite small or are evidently degenerate forms. With a few exceptions it is present in mollusks, echinoderms, annelids, arthropods, and all chordates. In its simplest form it consists of branching and anastomosing tubes which contain blood. The walls of the tubes are composed of flattened epithelial cells (endothelium) which may be surrounded on the outside by muscle or connective tissue fibres. The blood which fills these vessels consists of a fluid or plasma within which floating cells or corpuscles are almost invariably present. With increasing complexity of this system the walls of the vessels become thicker by increase of the muscular or connective tissue coats, and in certain parts of the system the vessels become larger. The muscular walls may be pulsatile throughout the entire length of a vessel, or this function may be limited to a small portion of a large vessel, which is then known as a heart; even in the highest animals the heart is only a differentiation of a simple pulsatile blood vessel. The vessels leading away from the heart are the arteries, those through which the blood flows back to the heart the veins, while the small thin-walled vessels connecting the two, and through the walls of which plasma escapes

FIG. 10

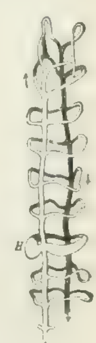


FIG. 11

FIG. 10.— Circulatory and nervous systems of a snail (*Paludina*) (from Claus after Leydig).— *F*, tentacles; *Oe*, œsophagus; *Cg*, cerebral ganglion; *Pg*, pedal ganglion and otocyst; *Vg*, visceral ganglion; *Phg*, pharyngeal ganglion; *A*, auricle of heart; *Vc*, ventricle; *Aa*, abdominal aorta; *Ac*, cephalic aorta; *V*, veins; *Vc*, branchial veins; *Br*, gills.

FIG. 11.— Anterior part of the circulatory system of an annelid (*Sænuris*).—The arrows indicate the direction of the flow. *H*, heart-like enlargement of a commissural vessel.

into the tissues, are the capillaries. Among the annelids there is a large dorsal vessel and a ventral one, which are connected in each somite by commissural vessels. The dorsal vessel is pulsatile along its whole length, and peristaltic contraction waves can be seen in a living worm

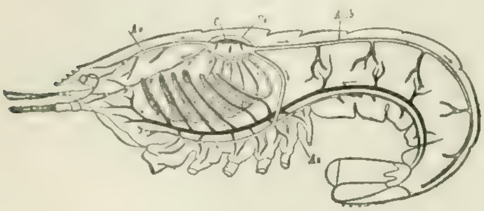


Fig. 12

Fig. 12.— Circulatory and respiratory systems of the crayfish (from Claus).— *C*, heart with three pairs of ostia; *Ps*. pericardium; *Ac*, cephalic aorta; *A. ab*, abdominal aorta; *As*, sternal artery. The arrows indicate the direction of the flow.

to pass from the posterior to the anterior end; correspondingly the blood flows forward in the dorsal vessel, down through the commissural vessels into the ventral one, and then backward through the latter to the posterior portion of the body, where the blood ascends through commissural vessels to the dorsal vessel, after which the same circuit is repeated. Throughout this whole course the blood flows through vessels with definite walls, and the circulation is said to be closed. Among the mollusks and arthropods a heart is present which is more concentrated and complete than among the annelids. In the arthropods this consists of a thick-walled, pulsatile tube lying on the dorsal side of the body and extending through several somites; in each somite are a pair of openings, the ostia, which open into the heart from the pericardium, and through which returning blood enters the heart. Among the mollusks the heart is also of a compact type and is divided into auricular and ventricular portions. Primitively two auricles are present, though in some gasteropods this number is reduced to one; in all mollusks there is but one ventricle. In primitive arthropods and mollusks the blood flows out of the ventricle at both the anterior and posterior ends; in more highly differentiated members of these phyla, out of the anterior end only. Among the arthropods the vascular system is very incomplete, the arteries soon end in lacunar spaces in the tissues, and from these spaces the blood is gathered into large sinuses and thence flows back to the heart. These lacunar spaces and sinuses are not true vessels, since they do not have definite walls, but are derived from the primary and secondary body cavities; the circulation is therefore an open one. Among mollusks the vascular system is more extensive than among arthropods, but here also the circulation is open, the arteries being connected with the veins by a system of lacunar spaces instead of capillaries. Finally among the echinoderms and chordates the circulation is closed as among the annelids; that is, the blood throughout its entire circuit is contained within definite vessels.

The manner in which blood is supplied to the respiratory organs is of great importance in explaining the structure of the circulatory organs in air-breathing vertebrates. Among annelids, arthropods, and mollusks the blood flows directly from the heart to all parts of the body, whence it is gathered into trunks which carry it to the gills; from these organs it is then returned purified to the heart. In the fishes the blood passes from the heart directly to the gills, whence it is gathered into the dorsal aorta and distributed to all parts of the body; it is then returned laden with waste product from the tissues to the heart. In these animals the heart consists of a single auricle and ventricle, essentially a simple tube more or less bent upon itself. In air-breathing amphibia a part of the blood passes directly from the heart to the lungs, whence it returns to the heart oxygenated, while a part of it goes at once to the body; the former is known as the pulmonary, the latter as the systemic circulation. In these animals the heart is incompletely divided by a partition which separates the auricular chamber into two auricles, but which leaves the ventricle undivided. The blood returning from the body is carried into the right auricle, while that from the lungs goes into the left; in the ventricle both kinds of blood mingle to a certain extent, though by a peculiar arrangement of folds and valves the larger part of the oxygenated blood which enters the left auricle is pumped to the anterior part of the body, while the blood from the right auricle goes to the lungs and to the posterior

Fig. 13

Fig. 14

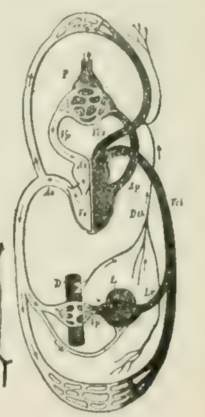


Fig. 15

Fig. 13.—Heart and great blood-vessels of the turtle (from Claus).—*Ad*, right auricle; *As*. left auricle; *Ao. d*, right arch of the aorta; *Ao. s*, left arch of the aorta; *Ao*, dorsal aorta; *C*, carotids; *Ap*, pulmonary arteries.

Fig. 14.— Aortic arches of a mammal, and their relations to the five embryonic arches (from Claus).— *c, c'*, carotids; *A*, aorta; *Ap*, pulmonary artery; *Aa*, great arch of aorta.

Fig. 15.— Diagram of a heart completely divided into right and left halves, and of a double (systematic and pulmonary) circulation (from Claus).—*Ad*, right auricle; *Vcs*, anterior vena cava; *Vci*, posterior vena cava; *Vd*, right ventricle; *Ap*, pulmonary artery; *P*, lung; *Vp*, pulmonary vein; *As*, left auricle; *Vs*, left ventricle; *Ao*, aorta; *D*, gut; *L*, liver; *Vp*, portal vein; *Lv*, hepatic vein.

parts of the body. Finally in all birds and mammals and in the highest reptiles (*Crocodilia*) the heart is completely divided by a partition into two auricles and two ventricles, and a double circulation, systemic and pulmonary, is established. The blood from the left ventricle goes

at once to all parts of the body, whence it returns to the right auricle; it then falls into the right ventricle and is pumped from that to the lungs; here it is oxygenated and returns to the left auricle, and then from the left ventricle is again sent out to all parts of the body.

7. *Excretory System.*— Excretion is the process of removing non-gaseous waste products, particularly urea and allied compounds, from the body. These nitrogenous waste substances are formed as the result of proteid combustion within the body, and as this form of metabolism is universal among animals nitrogenous waste substances are everywhere formed. With few exceptions all animals possess some form of excretory organ; in fact this is one of the distinguishing characteristics of animals as contrasted with plants. Among the *Protozoa* the excretory organ is a pulsatile vacuole which gradually fills with fluid containing these waste products and then suddenly contracts, forcing this fluid out of the body. Among cœlenterates excretion is probably performed by isolated gland cells, so that no single organ exists for this function; even among higher animals excretion is performed to a limited extent by individual cells or small glands; for example, the chlorogogue cells of annelids, the dermal glands of *Crustacea*, and the sweat-glands of mammals. In all higher animals a special excretory organ exists; this usually consists of minute tubules formed of cells which take up the waste substances and pass them into the tubule, whence they are carried to the exterior; such an excretory tubule is known by the general name of nephridium. The forms of nephridia differ considerably in different phyla, but two principal types may be recognized; these are the protonephridium, or water vascular system, and the metanephridium (Hatschek). The protonephridium is found in the flat worms and rotifers; that is, among worm-like animals with-

FIG. 16

FIG. 16.— Structure of the protonephridium (excretory organ) of a flatworm (from Hatschek).—*A*, part of the excretory apparatus of a tapeworm; R, edge of body; C, collecting tubules.— *B*. Terminal cells with flame of cilia.— *C*. Diagram of terminal cell, excretory capillary, and canal.

out a secondary body cavity; it is also found as the larval excretory organ (head kidney) in annelids. It consists of a pair of more or less branched tubules opening at one or more places to the exterior, while the internal terminations of the tubules each end in a single large cell which closes the end of the tubule and bears a tuft of long cilia projecting into its lumen. This tuft beats with undulatory movement and looks somewhat like the flickering flame of a candle, whence it is called a "flame" and the large cell which bears it a "flame cell." The tubule itself is usually composed of a single series of long glandular cells so perforated

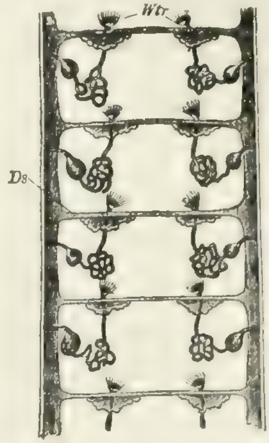


FIG. 17

FIG. 18

FIGS. 17, 18.— Diagrams of the excretory system in an annelid and in a shark (from Claus after Semper). —*Ds*, dissepiments; *Wtr*, ciliated funnels; *Ug*, segmental duct.

that the lumen is intracellular. In larger branches of the protonephridium the walls of the tubule may be formed of many cells which are ciliated on the side next the lumen. These cilia as well as the flame drive fluids within the lumen to the exterior. It is probable that these fluids are transuded body fluids and that the excretion of the waste substances is brought about by the activity of the cells which form the walls of the lumen.

The metanephridium is found among annelids, mollusks, molluscoids, prototracheates, and chordates, while a modified form of it exists in crustaceans. Typically it consists of a tubule opening to the exterior at one end and into the body cavity or some portion of it (pericardium or blood sinus) at the other. Where it opens into the body cavity the tubule is widened and covered with long cilia and is known as the ciliated funnel or nephrostome. Following this is the glandular portion of the tubule, consisting of a single series of perforated cells, or in other cases of an epithelium, composed of many cells, which forms the walls of the lumen. In either case these cells are glandular in character and are the real excretory cells, taking urea from the blood and passing it into the lumen of the tubule. The latter is ciliated throughout, and by the action of these cilia, together with those of the ciliated funnel, cœlomic fluid is drawn into the tubule through the funnel and driven to the exterior, thus flushing the tubule and carrying away the excreted substances. Finally the terminal portion of the tubule, which is derived as an invagination from the ectoderm, serves as a collecting tube or reservoir. Generally a single pair of these tubules is found in unsegmented animals, such as *Mollusca* and *Molluscoidea*; this number may be reduced,

however, as in the *Polyzoa*, where they are entirely lacking, or in certain *Gasteropoda*, where one of them is suppressed, or it may be increased as in the case of certain *Cephalopoda* (*Tetrabranchia*), where two pairs are present. In segmented animals, such as annelids, prototracheates, and chordates, it is probable that originally one pair existed in every somite, and this is still approximately the case in some of the simplest members of these phyla, while in higher forms they are limited to certain segments and have disappeared from others. The segmental character of these organs is so characteristic in the phyla named that they are called "segmental organs."

Among the *Chordata* these organs undergo modifications which deserve especial mention. They lie at the dorsal side of the body cavity and on each side of the notochord. Only in *Amphioxus* do they open individually to the exterior; in other chordates the peripheral ends of the tubules unite on each side into a duct which grows backward and opens into the cloaca near the anus; this is the segmental duct. This earliest system of segmental tubules in chordates is known as the pronephros, and it extends throughout the entire trunk region of the lowest vertebrates (cyclostomes), though in all higher forms it is limited to a few anterior somites and is usually a purely embryonic organ. Among these higher forms longer and more complicated tubules are formed in the somites behind the pronephros, which also open into the segmental duct at one end and into the body cavity at the other; near the ciliated funnel a knot of blood vessels forms on the side of the tubule and projects into its lumen; this is the glomerulus or malpighian corpuscle. Many of the tubules in this region then lose their ciliated funnels and no longer open into the body cavity, the tubule being flushed out by transuded plasma from the glomerulus; at the same time the single pair of tubules originally present in each somite may give rise to others by budding, so that several may be found in each somite. This second form of the nephridial system of vertebrates is known as the mesonephros, and is the permanent excretory organ of fishes and amphibians, while only an embryonic organ in reptiles, birds, and mammals. Finally, in the last named classes, the definitive kidney or metanephros appears in several of the somites posterior to the mesonephros. Its tubules, while similar to those of the mesonephros, are still more complex, having no trace of a ciliated funnel, and by budding very many of them are formed in each somite. The duct into which they open, the ureter, is an outgrowth of the segmental duct. It is thus to be seen that the very complex excretory system of vertebrates can be derived, step by step, from the simple nephridial system of such invertebrates as the annelids.

Finally, the nephridia may carry off from the body cavity not only cœlomic fluid, but also cells which are set free into this fluid; some of these cells in the annelids may be loaded with urates which are thus carried to the exterior (chlorogogue cells), but the most important of the cells which thus escape from the cœlom are the sex cells, ova and spermatozoa. The nephridia may be especially modified for carrying off these sex cells, in which case they are known as gonoducts. Even among the vertebrates the oviducts and spermiducts (*vasa deferentia*) are derived from the nephric

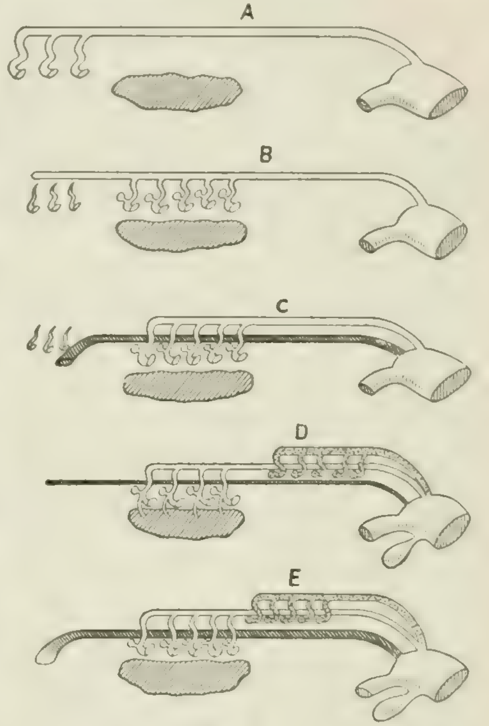


Fig. 19

Fig. 19.— Diagrams illustrating the development of the urino-genital organs of a vertebrate (after Parker and Haswell).—*A*, pronephros and segmental duct; *B*, atrophy of pronephros, development of mesonephros; *C*, appearance of Müllerian duct; *D*, development of metanephros, male type; *E*, the same, female type. The sex gland, ovary, or testis is obliquely shaded; phonephros and mesonephros unshaded; metanephros stippled; Müllerian duct heavily shaded. The large chamber to the right, into which these ducts as well as the intestine open, is the cloaca.

system. The former in most vertebrates arises in the embryo as part of the segmental duct and opens into the body cavity at its anterior end through a pronephric tubule; the latter is the remainder of the segmental duct, and in animals above the amphibians, which have a metanephros and ureter, acts exclusively as a spermiduct.

8. *Reproductive System.* — Reproduction among animals is both sexual and asexual; the former occurs among all animals, the latter is limited to the lower forms and to the constituent cells of higher ones. Sexual reproduction or amphigony consists in the union of two cells, the sex cells or gametes, to form a single cell of double origin, the oosperm or zygote, from which a new individual similar to the parental form develops. If the gametes are approximately equal in form and size their union is spoken of as conjugation, if they are very unlike in these respects they are called ova and spermatozoa, and their union is known as fertilization. Both conjugation and fertilization occur among the *Protozoa*, whereas all *Metazoa* reproduce by means of differentiated sex cells, namely, ova

and spermatozoa. In a few animals ova have the power of developing without previous fertilization, the process being known as parthenogenesis. If such development without fertilization occurs in larval forms which have not completed their development it is known as pædogenesis. In most animals the sexes are separate,—that is, ova and spermatozoa are produced by different individuals, males and females, and the species is diœcious; in some cases, however, both kinds of sex cells are produced by the same individual, which is then said to be hermaphrodite, and the species to be monœcious.

The essential reproductive organs are the gonads, or the glands which produce ova and spermatozoa, namely, the ovaries and the testes. In sponges the reproductive cells are scattered through the mesoderm so that in these animals ovaries and testes cannot be said to exist. In the lowest cnidarians (*Hydrozoa*) the sex cells are at first widely scattered in the ectodermal epithelium, but they actively migrate to certain portions of the hydroid stem where reproductive buds are being formed, and, aggregating here, form gonads. In all higher animals definite gonads are present. No genital ducts are present in the cœlenterates, and none are needed, since the sex cells can escape directly into the water. In animals above the cœlenterates the sex cells are mesodermal in origin, and in most cases form a part of the epithelium lining the cœlom. In animals without a true cœlom the sex cells arise within tubes or glands the cavities of which may perhaps represent the cœlom. In flatworms the gonads occur in considerable numbers in a single individual. In roundworms they are limited to one or two tubes, in rotifers, mollusks, molluscoids, and echinoderms they are confined to one or at most a few sex glands, while in segmented animals they are found in primitive forms in every body somite, though with advancing organization they become limited to a few segments or even to one. In most animals above the cœlenterates some form of duct exists for carrying the sex cells to the exterior; among the flatworms, roundworms, and rotifers these ducts are never the excretory tubules, though they may possibly represent the cœlom of higher animals. In these higher forms they are frequently metanephridia, or modified excretory ducts.

In many animals the ova and spermatozoa escape directly into the water, and there the eggs are fertilized and undergo development; it is probable that in these animals the escape of ova stimulates the males to eject spermatozoa so that both kinds of sex cells are shed at about the same time. In such cases enormous numbers of sex cells are produced and very many are wasted. A slight advance over this condition is found in those animals (frogs, bony fishes, etc.) in which the openings of the male and female ducts are placed close together at the time of shedding the sex cells; this is known as external copulation. In other cases the spermatozoa only escape from the body, and by means of currents of water they are carried into the body of the female, where they fertilize the ova *in situ*, as in sponges, or in certain receptacles into which the eggs are collected, as in fresh-water mussels. In other animals copulatory organs exist which serve to introduce spermatozoa into the sex ducts of the female, thus increasing the chances for the fertilization of the ova; this is internal copulation. In many cases copulation occurs but once, and the spermatozoa are stored in a seminal receptacle which opens into or near the oviduct. Internal copulation is a necessity in all land animals and in parasites, and it also occurs in many phyla of invertebrates (flatworms, roundworms, rotifers, gasteropods, cephalopods, annelids, arthropods).

In certain animals the sexes differ not only with respect to the sexual apparatus but also in many other regards; when such differences are very marked they constitute what is known as sexual dimorphism. In such cases the male is frequently very degenerate in form, being sometimes not more than a hundredth part the size of the female and entirely lacking alimentary canal, sense organs, and nervous system (rudimentary males of rotifers, barnacles, etc.).

Asexual reproduction, or monogony, consists in the formation of new individuals by division of an old one. In one-celled organisms and in the constituent cells of higher animals this takes the form of cell division. In the lower *Metazoa* asexual reproduction is not limited to cell division, but the entire body or portions of it may undergo constriction and subsequent division, thus giving rise to new individuals. This division may be into equal parts, in which case it is called fission; or into unequal parts, when it is known as budding or gemmation. In animals which reproduce both sexually and asexually there is a more or less regular alternation of one method with the other; this is known as alternation of generations or metagenesis. The alternation of amphigony with parthenogenesis is called heterogony.

9. *Nervous System and Sense Organs.*— Sensation and co-ordination are manifestations of protoplasmic irritability, or that capacity of receiving and responding to stimuli characteristic of every cell. Animals, even the simplest, are sensitive to a variety of stimuli, among which may be mentioned mechanical, chemical, thermal, and electrical, as well as light, gravity, etc. These stimuli, acting on the organism, start changes in the protoplasm (impulses) which are transmitted to portions of the body distant from the point first stimulated and call forth the co-ordinated activities of many different parts. In higher animals there are special sense organs for receiving certain of these stimuli and specialized protoplasmic fibres (nerve fibres) for transmitting impulses, while nerve centres for co-ordinating activities appear very far down in the animal scale. In the lowest animals, however, there are neither nervous system nor sense organs, and yet through the irritability of the general protoplasm these functions are performed.

A protozoan reacts to all stimuli in the same way, and it is probable that however different the stimuli may be they produce essentially the same changes in the protoplasm. The sensations of *Protozoa*, if they can be said to have sensations, must be of the most general and indefinite sort, just as their responses to stimuli show the most monotonous sameness. The same thing is probably true of sponges, where none of the cells are differentiated for receiving and transmitting stimuli. In all other phyla, however, certain cells of the body are set apart for these particular functions, and

the greater the differentiation in these respects the more definite and varied are the sensations, the more swiftly impulses are transmitted to the motor system, and the more complicated are the responses.

Nervous System.— The elements out of which the nervous system is built are nerve cells and fibres, the latter being merely outgrowths of the former. In practically all *Metazoa* these cells are derived from ectoderm, and in a good many animals the sense organs and entire nervous system remain throughout life a part of the superficial epithelium which covers the body (*Cœlenterata, Chætognatha,* certain *Annelida, Molluscoidea,* many *Echinodermata, Balanoglossus*); such a nervous system is said to be epithelial. In all other *Metazoa* the nervous system, though formed from epithelium, separates from it in the process of development, so that brain, ganglia, and nerve trunks come to lie some distance from the surface of the body; this is known as an epitheliogenous nervous system. In addition to the two classes just mentioned, which are based on the relations of the nerve cells to the body layers, four types of nervous system are found among *Metazoa* which are based upon the relations of the nerve cells to one another; these are (1) the diffuse type, (2) the linear type, (3) the ganglionic type, and (4) the tubular type.

(1) A diffuse nervous system consisting of nerve cells and fibres scattered throughout the superficial epithelium is the simplest type known and is found among such animals as sea-anemones (*Actinozoa*); the nerve cells are here connected together by means of the fibres into a ganglionic plexus. (2) The next step in increasing complexity is represented by a linear nervous system such as is found in the jelly-fishes; here many nerve cells and fibres are aggregated into a double nerve ring around the

FIG. 20

FIG. 21

FIG. 22

FIG. 23

FIG. 20.— Diagram of the nervous system of a starfish (from Claus).— *N*, nerve ring.
FIG. 21.— Nervous system of a flatworm (*Mesostomum*). — *G*, cerebral ganglia and eyes; *St*, the two lateral nerve trunks; *D*, intestine with mouth.
FIG. 22.— Nervous system of the larva of a ladybug (*Coccinella*).—*Gfr*, frontal ganglion; *G*, cerebral ganglia; *Sg*, subœsophageal ganglion; *G′*— *G″*, ganglia of the ventral chain.
FIG. 23.— Nervous system of adult ladybug.— *Ag*, optic ganglion.

margin of the umbrella, thus forming a centralized nervous system; other nerve cells remaining, scattered throughout the epithelium, serve to connect the ganglia with the muscles. (3) The ganglionic type. In ctenophores, a sense organ from which nerves radiate, is found at the apical pole, and in a great many of the higher animals the earliest formed and most widely represented portion of the nervous sys-

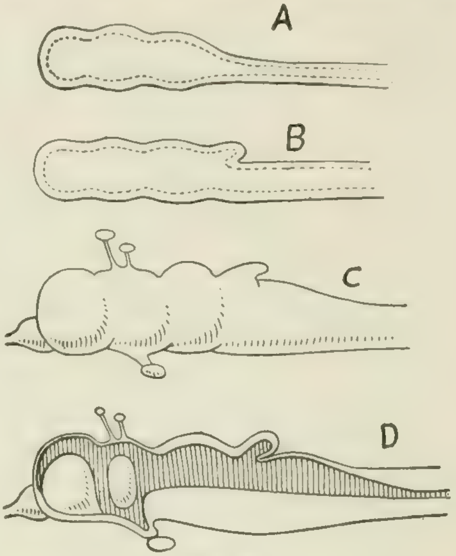


FIG. 24

FIG. 24.— Diagrams of the vertebrate brain (after Parker and Haswell).— *A*, first stage, with three brain vesicles; *B*, second stage, four brain vesicles; *C*, *D*, side view and sagittal section of fully formed brain without cerebral hemispheres.

tem is a sense organ and ganglion which appear at the apical pole of the gastrula, and becomes in the adult the cerebral ganglion or brain, lying on the dorsal side of the œsophagus. Nerve trunks are always given off from this ganglion, and very generally two of them run down on each side of the œsophagus to its ventral side, thus forming a circumœsophageal nerve ring. In different phyla longitudinal nerve trunks may be given off from different parts of this ring; among annelids, arthropods, mollusks, and molluscoids from the ventral side, and in annelids and arthropods this forms the "ventral chain," which consists typically of a pair of ganglia in each somite connected with those in front and behind by nerve cords. The first one in the chain is the subœsophageal ganglion, connected with the cerebral ganglion by the circumœsophageal commissures. In the mollusks the nervous system consists of a pair of supra- and sub-œsophageal ganglia (cerebral and pedal) which with their connectives form an œsophageal ring. To these is usually added a pair of pleural and of parietal ganglia forming a loop which extend back into the body, while ventral trunks (pedal cords) may be present in the foot. (4) The tubular type of nervous system is found only among the chordates; here the nervous system develops from an epithelial plate (neural plate) on the dorsal surface of the embryo, which becomes invaginated in such a way as to form a longitudinal groove, the neural groove. This then separates from the epithelium as a tube, which in all vertebrates is enlarged at its anterior end to form the brain. This neural tube,

while apparently a continuous structure, is really composed of segments, the neuromeres, one neuromere being found in each body somite; the neuromeres are thus comparable to the ganglia of the ventral chain of arthropods and annelids. This segmentation of the central

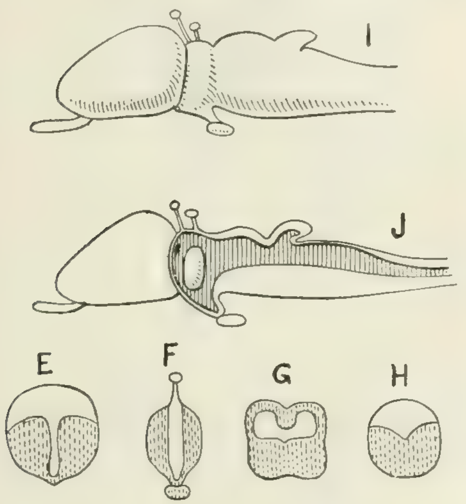


Fig. 25

Fig. 25.— Diagrams of vertebrate brain (after Parker and Haswell).— *E — H*, transverse sections of brain at different levels; *E*, of the cerebrum; *F*, of the 'tween brain; *G*, of the mid brain; *H*, of the hind brain; *I*, *J*, side view and sagittal section of a brain with cerebral hemispheres.

nervous system of vertebrates is indicated even in the adult by the segmental arrangement of the spinal and cranial nerves. In the embryonic development of all vertebrates the brain consists of three enlargements or vesicles, the fore brain, mid brain, and hind brain; the first gives rise to the cerebrum and 'tween brain of the adult, the second remains as the mid brain, while the third gives rise to the cerebellum and medulla. The portion of the neural tube posterior to the brain becomes the spinal cord of the adult. With the differentiation of nerve cells and fibres in the walls of the neural tube these walls increase greatly in thickness, while the originally large cavity of the tube becomes restricted in size, forming in the adult the ventricles of the brain and the central canal of the cord.

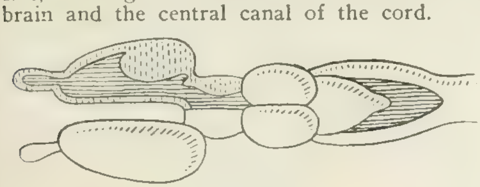


Fig. 26

Fig. 26.— Dorsal view of vertebrate brain with the cavities of the right side exposed (after Parker and Haswell).

Sense Organs.— The simplest sense organs are the scattered sensory cells found in the superficial epithelium of many animals; these may be solitary or aggregated into buds. They are elongated epithelial cells with a hair-like process at the free border and a fibre at the deeper end connecting with the branches of a ganglion cell. They are organs of general sensation,— that is, they are capable of receiving various kinds of stimuli, such as mechanical, thermal, electrical, and chemical, and are therefore largely undifferentiated, though probably chiefly subserving the sense of touch. These integumentary sense organs are found in almost every group of animals. Among the vertebrates they are present in primitive form over the general body surface; in the fishes and amphibia they are aggregated into buds, forming the lateral line organs, while among those vertebrates which do not dwell in water deeper-lying organs, of modified type, are found (tactile cells, corpuscles, and bulbs). In addition to these organs of general sensation, higher *Metazoa* generally possess specific sense organs, namely, those differentiated for the reception of particular kinds of stimuli. These are organs of (1) smell and taste, (2) equilibrium and hearing, (3) vision.

(1) Organs of smell and taste are present in all vertebrates and in many invertebrates. Their structure is extremely simple, being but slightly modified from the type of the primitive organs described above. In fact the olfactory sense cells of vertebrates are merely scattered sensory cells, while the organs of taste (taste buds) are simple aggregations of such cells. Throughout the *Metazoa* the organs of taste and smell are generally located in ciliated pits or depressions of the integument either on the head or at least near the mouth or respiratory organs. In these positions they serve in the one case to test food and in the other the quality of the medium used in respiration. Among fishes the olfactory organs are located in pits on the front of the head; in all air-breathing vertebrates these open posteriorly into the mouth cavity or pharynx, and thus form the anterior part of the respiratory tract. The organs of taste are of course in or near the mouth. Among the mollusks a sense organ which is probably olfactory in function, the osphradium, is located near the gills. Among the arthropods we find notable modifications of these organs owing to the fact that the entire body surface is there covered with an impermeable chitinous coat. These sense organs are here peculiar hollow tubes, the olfactory tubes or cones, which are borne on the anterior portion of the body, usually on the antennæ and mouth parts; these hairs are filled with fibrillar protoplasm which connects with sense cells at the base of the hair.

(2) Organs of hearing and equilibration are very widely represented throughout the animal kingdom. It is advisable to consider these two organ systems together, since the two functions which they subserve are united in the same general organ in the vertebrates, while in lower forms it is by no means easy to distinguish between the two. It has long been customary to speak of all vesicular sense organs containing free solid bodies as auditory in function, but it is much more likely that in the lower *Metazoa* they serve to acquaint the animal with its bodily positions,— that is, that they are organs of equilibration. In many respects the simplest type of organ of this class is found among certain jellyfishes. It here consists of a short tentacle situated in a depression of the ectoderm and bearing a solid body or otolith near its free end; by the movements of the tentacle the

hairs or protoplasmic processes of surrounding sensory cells are stimulated. In other *Medusæ* the sensory cells may entirely enclose the ten-

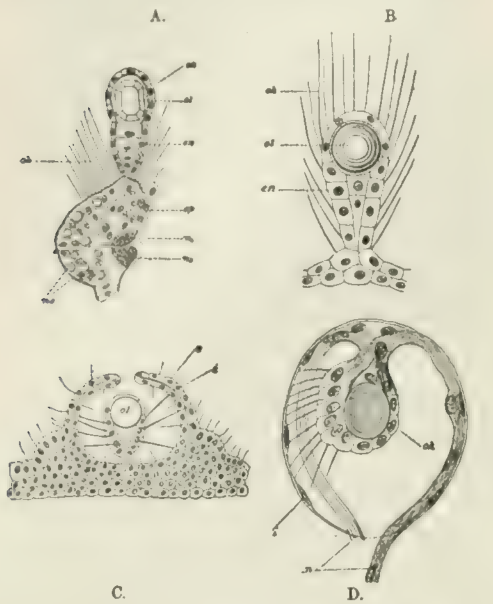


FIG. 27

FIG. 27.—Auditory or equilibrative organs of jelly-fishes (from Hatschek).—*A*, of *Cunarcha*. *B*, of *Pectis*. *C*, of *Rhopalonema*. *D*, of *Cumarina*. *Ok*, auditory tentacle; *Ol*, Otolith; *Oh*, auditory hairs; *n*, nerve.

tacle, thus forming an auditory vesicle or otocyst. The auditory organs of most vertebrates, as well as of most invertebrates, can be traced back to this simple type. The sensory cells forming the walls of the otocyst are similar to tactile cells,—that is, they bear processes projecting into the cavity of the otocyst, while the bases of these cells are connected with ganglion cells. By the movements of the otolith, usually a calcareous concretion, these cells are stimulated and the impulses thus generated conveyed away by the nerve fibre. Otocysts of this type are possessed by mollusks, certain

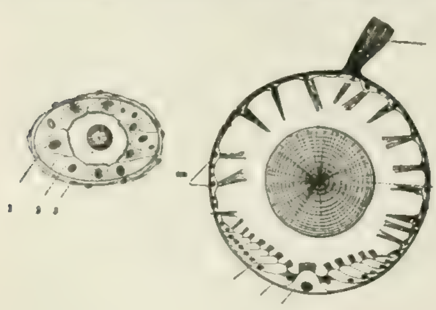


FIG. 28

FIG. 28.—Auditory or equilibrative organs of mollusks (from Hatschek).

annelids, turbellarians, and brachiopods. In the case of arthropods organs of a different type are generally found, owing to the fact that the body is here covered by chitin and that the fine protoplasmic processes or cilia are absent. Among the crustaceans the auditory organ usually consists of a cavity in the basal joint of the first antenna, which is open to the exterior and which contains water and grains of sand; the wall of the cavity bears chitinous processes or auditory hairs which have a nervous connection at their base; these hairs are stimulated by the movements of the water and sand within the auditory sac. Many insects have a true tone-perceiving organ, the chordotonal organ; in principle this consists of a few elongated cells, the chord, which are attached directly to the integument at one end and by a ligament to an opposite point of the integument; when this apparatus is thrown into vibration impulses are conveyed to the nerve cells attached to some portion of the chord. In other insects (*Orthoptera*) a tympanal organ may be present, consisting of a vibrating membrane overlying a tracheal chamber; sense cells are present between the membrane and chamber, and when the membrane is set into vibration by sound waves the sense cells are stimulated. Among aquatic vertebrates a system of integumentary

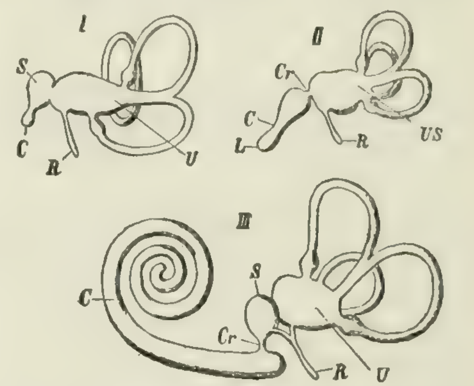


FIG. 29

FIG. 29.—Internal ear of different vertebrates. I, Fishes. II, Birds. III, Mammals. (From Claus.)—*U*, utriculus with semicircular canals; *S*, sacculus; *US*, utriculus and sacculus; *C*, cochlear duct; *L*, lagena; *Cr*, *canalis reuniens*; *R*, *recessus vestibuli*.

sense buds is found along the lateral borders of the body and over the head, which is known as the lateral line system. The function of these organs is not surely known, but it is probable that they are organs of touch and also of equilibration. In all vertebrates it is probable that the auditory organs, as well as the organs of smell and taste, have been derived from integumentary sense organs homologous with those of the lateral line. In the process of development the ear appears as a pit-like invagination of the skin which is then infolded to form a vesicle; this vesicle then becoming partially divided into two chambers, the utricle and the saccule. In most vertebrates the former bears three pairs of semicircular canals which are organs of equilibration, while the latter gives rise to a recess, the lagena, which becomes the cochlear duct in mammals and is a true auditory organ. Calcareous concretions or

otoliths are present in this much-folded and complicated otocyst. This sensory portion of the auditory organ is known as the inner ear;

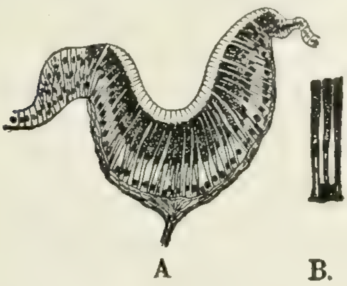


FIG. 30

FIG. 30.—*A*, section through the open eye-pit of a limpet (*Patella*); *B*, the two kinds of retinal cells, pigmented and sensory (from Hatschek).

to this is added in all animals above the frogs and toads a middle ear or tympanum which transmits the sound waves from the surface to the inner ear. Finally, in the mammals there are folds of the integument around the tympanic membrane which serve to collect sound waves and which constitute the external ear.

(3) *Visual Organs.*— Animals without any trace of eyes are sensitive to light (certain *Protozoa, Turbellaria, Larvæ*), and it must therefore be assumed that protoplasm may be directly stimulated by light without the intervention of any special organ. In its simplest form an eye consists of one or a few transparent cells partially surrounded by pigment in the form of a cup, so that the light can enter only from one side; the pigment not only absorbs light rays, but it optically isolates the cells within from those without this cup (some *Medusæ, Turbellaria, Annelidæ*). The function of such an eye is probably to determine the direction of light, since it could give no image of luminous objects. A slight advance over this simplest type of eye is found in the cup-shaped eyes of certain mollusks; here certain superficial epithelial cells are infolded to form a cup; in some cases deeply pigmented, while other intermediate cells remain clear and unpigmented. The latter

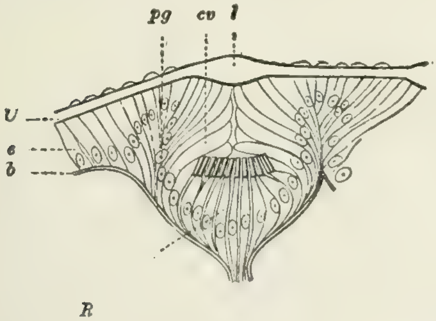


FIG. 31

FIG. 31.— Section through the eye of a water-beetle (*Hydrophilus*) (from Hatschek); *l*, chitinous lens; *cv*, transparent cells; *pg*, pigment cells; *R*, retina.

are the sensory cells and are connected at their bases with nerve fibres. If this cup-shaped eye becomes infolded still further and its opening grows smaller and finally closes altogether, it forms a vesicular eye such as is present in certain mollusks and annelids. The wall of this vesicle, which is turned toward the epithelium, is transparent and may become thickened to form a lens; the opposite wall of the vesicle is pigmented and is known as the retina. In such an eye the free ends of the retinal cells are turned toward the cavity of the vesicle, while the opposite ends, which are directed away from the vesicle, are prolonged into fibres; such an eye has a direct retina. This type of eye reaches its highest development among the cephalopods, where it bears a striking superficial resemblance to the vertebrate eye. A rudimentary eye of this type is present in all vertebrates as the pineal organ or gland. This is an unpaired structure on the dorsal side of the

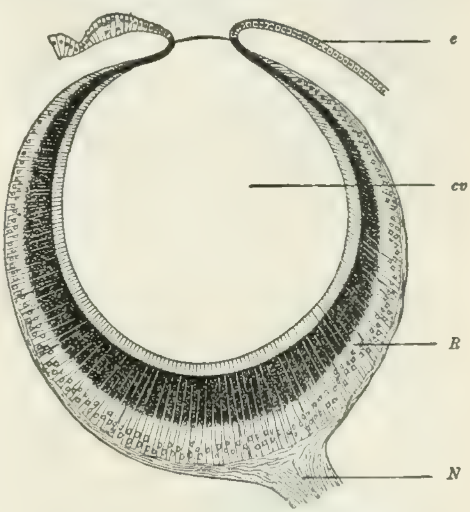


FIG. 32

FIG. 32.— Section through the cup-shaped eye of a gasteropod (*Haliotis*) (from Hatschek).— *e*, epithelium covering body; *cv*, vitreous body; *R*, retina; *N*, nerve.

'tween brain and in certain reptiles is plainly a vesicular eye with direct retina. The paired eyes of vertebrates are also vesicular, but in them the retina is inverse,— that is, the free ends of the retinal cells are directed away from the cavity of the vesicle, while the ends which bear the fibres are directed toward it. The explanation of this remarkable condition is found in the study of the development of these eyes. They arise as lateral evaginations of the walls of the embryonic fore brain, are then constricted from the brain, and become vesicles connected with the fore brain by only a stalk. At this stage the vertebrate eye is like the invertebrate one save only that it has arisen from the neural instead of the superficial epithelium. All the cells which form the vesicle have their free ends directed toward its cavity, while their basal ends are directed away from it. The outer wall of this optic vesicle is then infolded until it comes into contact with the inner wall, thus forming a cup open toward the skin. The ectoderm over

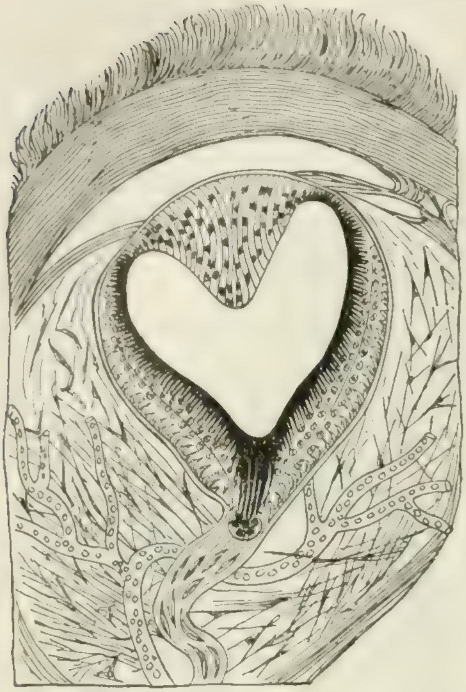


FIG. 33

FIG. 33.— Longitudinal section through the pineal eye of a lizard (*Sphenodon*) (after Baldwin Spencer), The eye is located in the middle of the dorsal side of the head and is covered by translucent scales. The outer wall of the eye vesicle is thickened to form a lens, while the inner pigmented wall is the retina from which the nerve proceeds.

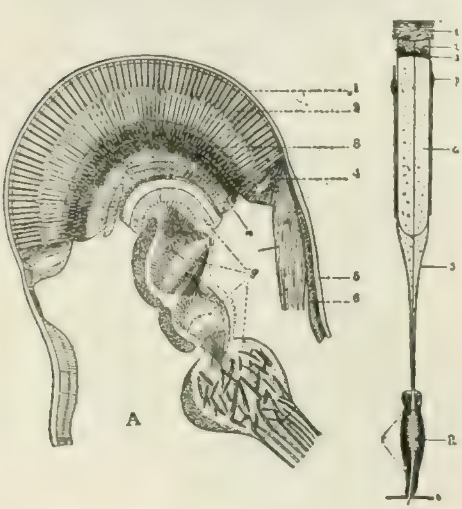


FIG. 34

FIG. 34.— A, section through the compound eye of a crayfish (from Hatschek).— 1, cornea; 2, crystalline cones; 3, retinulæ; 4, pigment cells; 5, cuticle; 6, epithelium; *n*, optic nerve, *g*, ganglia. B. A single element (ommatidium) from the compound eye of a crayfish.— 1, corneal lens; 2, corneal cells; 3, crystalline cone cells; 4, 5, outer and inner parts of the crystalline cone; *p*, pigment cells; *r*, retinula; *R*, rhabdome; *b*, basement membrane.

the opening of the optic cup is then infolded to form the lens, which completely separates from the surface and lies in the mouth of the cup. The infolded wall of the cup alone forms the retina, and therefore the free ends of the retinal cells are directed away from the lens and the cavity of the cup. The lens and optic cup are then surrounded by fibrous and vascular coats, the sclerotic and choroid; a chamber is formed in front of the lens which is filled with water or aqueous humor, while one behind the lens and in front of the retina is filled with vitreous humor.

The compound eye is another type found chiefly among arthropods. It consists of a large number of closely-packed single eyes or ommatidia, each of which is surrounded by pigment and is optically isolated from the others. Each ommatidium consists of (1) a hexagonal cornea at the surface, (2) a crystalline cone below this, and (3) the retinula or group of retinal cells which are connected with nerve fibres. The cornea and crystalline cone are refractive and serve in the capacity of a lens, while the retinula alone is the sensory element.

EDWIN GRANT CONKLIN,
University of Pennsylvania.

Anatomy of Melancholy, The, a famous work by Robert Burton (1577–1640). It was first issued in 1621 under the name 'Democritus Junior,' and was revised five times by the author before his death. It is divided into three systematic sections devoted respectively to the causes and symptoms of melancholy, its cure, and of amorous and religious melancholy. It is in effect an *omnium gatherum* of all sorts of out-of-the-way lore, from diet to demonology, and its literary felicity and humor have aided in keeping it alive as genuine literature.

Anatomy of Plants. The cell, the elementary organ of plants and animals, was first observed by the English micrographer Robert Hooke (1667), who suggested the name "cell" because of its resemblance to the cell of a honeycomb. A few years later another English author, Nehemiah Grew, extended this observation and published the first work on plant-anatomy (1672), in which he described the minor structure of leaves, stems, and roots, and introduced several anatomical terms still in use. Grew was soon followed by an Italian, Marcello Malpighi, the author of the illustrious work, 'Anatome Plantarum' (1675), and these three men are thus the founders of the science of plant anatomy. Many years later Robert Brown (1833) detected the nucleus in the cell, and the German botanist Schleiden (1838) pointed out the general occurrence of this new body within the cells of plants and its importance to the cell-division. These discoveries soon led to the apprehension of the cell as being the elementary organ of plants, and when the occurrence of nucleus had been proved also in the cells of animals the German naturalist Schwann (1839) advanced the important doctrine that bodies of animals and plants consist of cells and the products of these.

While the nucleus had thus been detected and described to some extent, there still remained a closer examination to be made of the other parts of the cell-content, which some of the earlier investigators had already observed and described as a soft, gritty matter, capable

of motion in the cell. This cell-content was studied by Mohl (1846), who gave it the name protoplasm. The constituents of the cell were thus properly defined as the cell-wall, the protoplasm, and the nucleus. Of these the protoplasm and the nucleus are the most essential parts, since the wall is not always developed, but is totally absent in numerous animal-cells and also in those of several plants among the lower *Algæ* and *Fungi*, at certain stages, for example. A completely developed plant-cell may for the most part be defined as a microscopical, closed vesicle consisting of a wall, and the contents, nucleus, protoplasm, and cell-sap. The shape of the cell presents a vast number of forms, generally referred to only two types: the parenchymatic and the prosenchymatic. Of these the parenchymatic is either isodiametric or elongated, but with blunt ends and usually thin-walled, while the prosenchymatic is mostly elongated with pointed or sharp endings, and is more or less thick-walled. A third type of cell may be mentioned, the "hypha" of certain *Algæ* and *Fungi*, which is very thin, thread-like, and composed of a single cell or many. There are plants consisting of one cell only, but most plants are composed of an enormous number, which together constitute the so-called "cellular tissues," parenchyma and prosenchyma, in respect to the shape of the cells of which they are composed. The function performed by these tissues is very different, and the classification as parenchyma and prosenchyma is thus not sufficient, since this only applies to the external shape of the cells. In accordance with both structure and function the following tissues are observable in the higher plants: Epidermis, the mechanical tissue, the conductive tissue, and the fundamental tissue; the first and the last of these tissues being parenchymatic, the others prosenchymatic.

The minor structure of these various tissues may be described as follows:

Epidermis.— This is the outermost cell-covering of a plant-organ, such as the leaf, stem, and root, and consists of at least one layer of cells. The outer cell-wall is often considerably thickened and invariably covered by a thin membrane, the so-called cuticle (*c* in Fig. 1) which

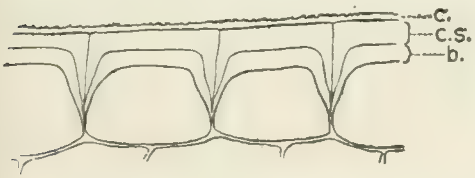


Fig. 1.— Epidermal cells of the leaf of aloe: *c*, the cuticle; *c.s.*, cuticular layers; *b*, cellulose.

is highly impermeable to water, and especially well-developed in land-plants; in submerged water-plants the cuticle is, on the other hand, much reduced. The epidermal system of plants has a threefold significance: it protects the more delicate parts of the organs against mechanical injuries, pressure, etc.; it forms a protection against evaporation by being impermeable to water and water-vapor, and forms also a water-supplying system. These three functions are expressed by various development of the cells, which may be illustrated by a section of a leaf of aloe (Fig. 1) in which all three epidermal peculiarities are quite well developed. The thick cuticle and cuticular layers

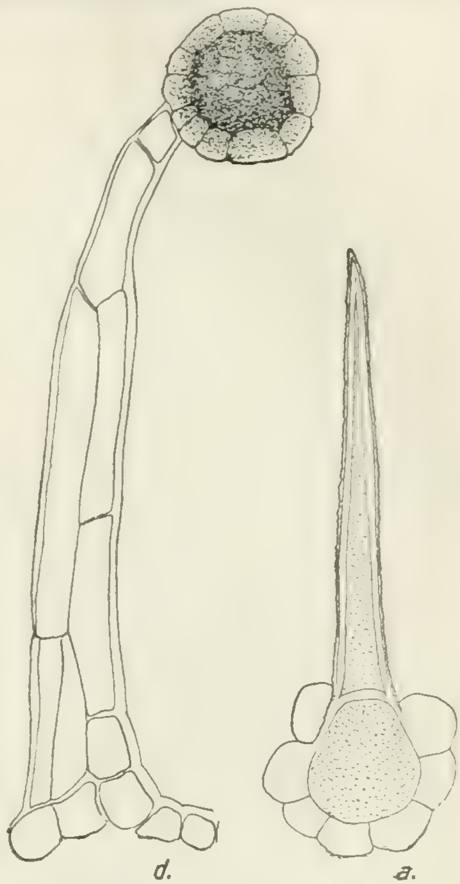


Fig. 2.— *a*, simple hair of *Mertensia*: *d*, glandular hair of *Saxifraga*.

form an excellent protection against loss of moisture, while the thickening of the outer cell-wall and portion of the radial walls furnishes the mechanical support. Characteristic of epidermis, furthermore, is its covering of hairs, which present a number of forms, and of which the majority are developed from the epidermis itself. Some of them consist only of a single

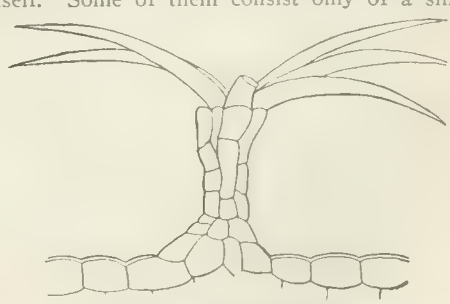


Fig. 3.— Branched hair of *Croton*.

cell, but usually they are composed of several. The hairs may be simple (Fig. 2. *a*) or branched (Fig. 3), and attain various forms from sharply-

pointed to globose, scale-like (Fig. 4) or star-shaped. The ordinary hairs contain only air, and when occurring as a dense covering of the

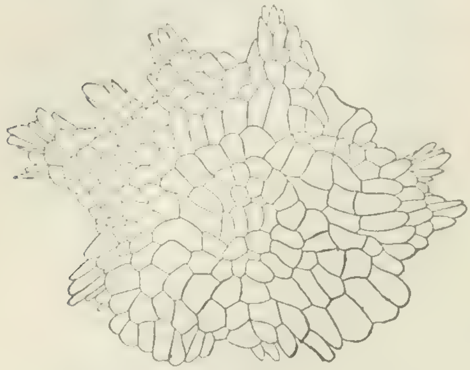


FIG. 4.— Scale-like hair of *Tillandsia*.

plant-organ aid materially in the protection against loss of moisture, thus entering directly into the function of epidermis. Other hairs contain and secrete ethereal oils, the so-called glandular hairs (Fig. 2 *d*), which may serve for attracting insects to carry the pollen, or if the secretion is of a sticky consistence, the function may be to keep off injurious, crawling insects, less adapted for aiding in cross-fecundation. Several hairs contain poisonous matters and cause great pain when touched, as for instance the hairs of the common nettle, but the physiological significance of such and other hair structures is not satisfactorily explained.

A very simple structure is possessed by the root-hairs, which consist of only a single epider-

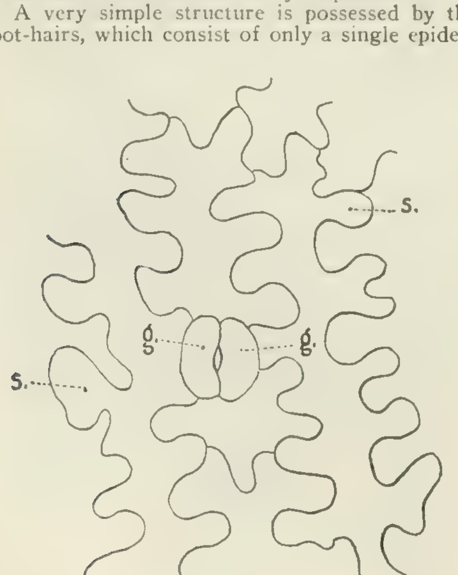


FIG. 5.— Epidermis, with stomata, of *Medeola: g*, the two guard-cells; *s*, the subsidiary cells.

mis-cell, and of which the function is to absorb and conduct food substances in solution. A purely mechanical function is exhibited by the climbing-hairs,— that is, hairs in the shape of hooks by which the weak stems of certain plants — for instance, hop, cleavers, etc.— are able to climb by attaching themselves to other plants.

Finally to be mentioned are the stomata. If the epidermis be able to regulate the evaporation, it is readily understood that this tissue must be compact and without intercellular spaces unless these be capable of closing and opening themselves under certain conditions. Such intercellular spaces occur in the epidermis

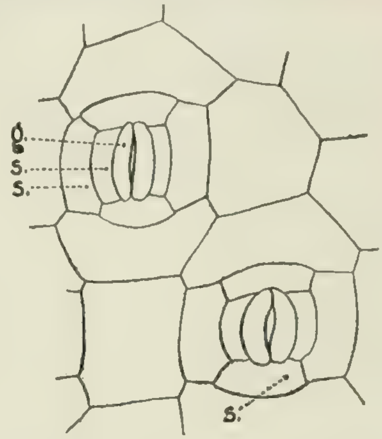


FIG. 6.— Epidermis, with stomata, of *Commelina: g*, guard-cell; *s*, subsidiary cells.

and were by De Candolle named "stomata." Each stoma consists of two crescent-shaped cells (*g* in Fig. 5), the guard-cells, which turn their concave faces against each other, thus forming an intercellular space leading into a wide cavity, the so-called air-chamber (*ac* in Fig. 7). Adjoining the guard-cells are usu-

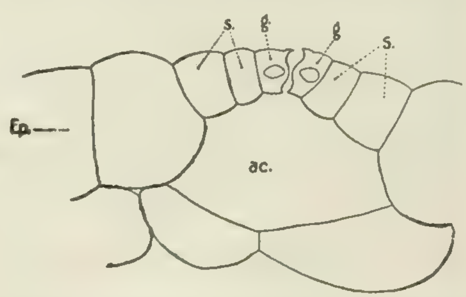
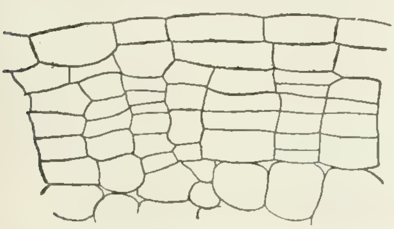


FIG. 7.— Cross-section of a stoma from the leaf of *Commelina: ac*, the air-chamber; *g*, guard-cells; *s*, subsidiary cells.

ally two or more epidermis-cells of a shape somewhat different from the others, and these have been called the subsidiary cells (*s* in Fig. 5); their number and manner of arrangement is often very variable in several orders of the phanerogams. The guard-cells are, as a rule, the only cells of epidermis which contain chlorophyll and starch; they have the power of closing or opening the orifice of the intercellular space, a phenomenon that has been studied and explained by Schwendener. When moist these

cells become swollen, and, as they lengthen, curve outward in the middle so as to leave a free opening. An opposite movement takes place when they become dry: they are then shortened and straightened with their inner faces applied to each other, closing the orifice. Stomata occur as a rule on all green plant-organs, stems, and leaves, but lack in those that are constantly under water, and they are totally absent in the thallophytes. The location of the stomata varies somewhat, but they are more numerous on the lower face of the leaves than on the upper. Their position offers a number of variations and is sometimes dependent upon the nature of the surroundings, especially of the climate, the dryness of the air, etc. The guard-cells may be free, reaching above the surrounding epidermis (Fig. 7), or they may be sunk below this. A very peculiar arrangement is noticeable in *Nerium,* where the stomata are located, several together, in depressions of the leaf-surface. A modification of stomata are the so-called water-pores, exhibiting a like structure, but somewhat larger than these and unable to open or close themselves. They are mostly located on the margins of leaves near the ends of the nerves.

The Cork.— While the epidermis is seldom of any long duration in plant-organs which



C.

Fig. 8.— Cross-section of the stem of *Trifolium,* showing the cork (*c*).

persist for more than one season, another covering becomes necessary and is represented by the so-called cork. This tissue may be developed by the epidermis itself, but in most instances it originates in the parenchymatic layers underneath the epidermis, or sometimes much deeper, in the innermost portion of the cortex, for instance. The cork is able to continue its growth, following the increase in thickness of the stem, and consists of several strata of quadratic or rectangular cells, arranged in compact rows, vertical on the surface of the plant-organ (Fig. 8).

The Mechanical Tissue.— The best known elements of this tissue are the so-called "stereome-cells," which are thick-walled, very long prosenchymatic cells, of which the walls have narrow pores and consist of cellulose. The stereome-cells are mostly arranged in strands and located in such portions of leaves or stems as are the most exposed to injury. The cells are very flexible, and the arrangement of the layers is remarkably well fitted for rendering the plant-organ the greatest possible support by means of the smallest quantity of material, as demonstrated by Schwendener. Besides this function the mechanical tissue is also observed to form protective layers around the mestome-bundles, especially near the leptome-elements.

Another thick-walled but parenchymatic cell-form is the so-called sclerotic, occurring in the cocoa-nut, walnut, etc.

The collenchymatic cells may be mentioned here: they are elongated, prismatic cells of which the walls are thickened only in the corners and consist mainly of cellulose. Collenchymatic tissue is frequent in the periphery of stems of herbaceous plants, and in leaves, near the larger nerves of these.

The Conductive Tissue.— This tissue is represented by the so-called "mestome-bundles," or "vascular bundles" of earlier authors, which traverse the plant-organs mostly in a longitudinal direction; they constitute a part of the nerves in leaves and of the wood in trees. Their composition is often very complicated, especially in stems and roots, where they are often associated with some of the other tissues, from which they are not always readily distinguished. At present "mestome," as proposed by Schwendener, comprises only two elements, "leptome" and "hadrome," of which the former conducts albuminous matters and contains the sieve-tubes and the medullary ray-parenchyma. The hadrome contains the vessels and the woody parenchyma and conducts the water. These terms, leptome and hadrome, are not identical with the "phloëm" and "xylem" formerly suggested by Nägeli, since this author included the mechanical tissue, the stereome, which is often developed in almost immediate connection with the true conductive tissue.

Mestome-bundles, containing leptome and hadrome, are observable in all the higher plants: vascular cryptogams and phanerogams, but are not developed in any of the thallophytes (*Fungi* and *Algæ*) or in the mosses. In regard to the various cell-forms represented in the conductive tissue or mestome, the so-called vessels play an important role by their characteristic structure. Vessels are tubes which have been developed from cell-rows whose transverse walls have either entirely or partially disappeared, leaving ridges or rings, and of which the longitudinal walls are strengthened by various thickenings. The so-called "tracheids" are somewhat modified forms of vessels, but hardly distinguishable from them except by their narrower width. Both vessels and tracheids occur under the same types as "spiral," "reticular," "scalariform" and "porous," in accordance with the manner of thickening observable in their walls; of these the porous tracheids are particularly numerous. The wood of conifers consists exclusively of such porous tracheids, which are especially characteristic by the pores being bordered.

The woody parenchyma and medullary rays resemble in structure those parenchymatic cells having numerous rounded, simple pores, but differ in their position and arrangement: the former usually extending longitudinally in the shape of bands, while the medullary rays represent radial bands or plates. Some distinction is also noticeable in the shape of these cells: that of the wood-parenchyma being elongated in the direction of the axis of growth, while the cell of the medullary ray is chiefly elongated in a radial direction.

The leptome contains, as stated above, the sieve-tubes with the cambiform. This tissue differs widely from the hadrome in the great

softness and much narrower lumen of its individual cells. The sieve-tubes are usually elongated cells of which the transverse walls exhibit a very distinct perforation, whence the term sieve-plate is generally given to this particular cell-wall. The openings in the sieve-plates permit the circulation of undissolved albuminous matters. The sieve-tubes and plates are often difficult to observe on account of their delicate structure and minute size; they are, however, well distinguishable in the stems of the grape-vine and of the *Cucurbitaceæ*.

There is still a small conducting system, which may be mentioned here, although belonging either to the leptome or the hadrome. It is the lactiferous tissue, containing the so-called milk-tubes, often located in the neighborhood of the leptome. The cell-wall consists of cellulose: it is as a rule very thin and without pores or thickenings. The milk-tubes of certain species of *Euphorbia* differ from the type by being thick-walled and slightly porous. The content is a milky juice, mostly whitish, seldom yellow, as in celandine (*Chelidonium*), or reddish as in bloodroot. Milk-tubes occur as "ducts" or "cells," and are developed in different ways. The "ducts" are formed by parenchymatic cells arranged in rows, and of which the radial cell-walls become dissolved entirely. The "cells" are, on the other hand, single cells, which grow out into long and branched tubes similar in some respects to the so-called "hyphæ" of certain fungi.

The Fundamental Tissue.— This tissue comprises all the other tissues of the plant not referable to the epidermis, the mechanical, or the conductive tissue, and is as a rule composed of thin-walled, parenchymatic cells with distinct intercellular spaces. Its function is principally to prepare and store nutritive matters, hence the chlorophyll, the starch, and similar matters are contained in this tissue. Several types of fundamental tissue have been distinguished in the various plant-organs, such as the cortex in stems and roots; the pith in stems, but only occasionally in roots; the mesophyll with the palisade- and pneumatic-tissue in leaves; and finally the parenchymatic sheaths, which often surround the mestome-bundles as the endodermis, the mestome-sheath, etc.

The location of these various types of the fundamental tissue is as follows: The cortex, whose outermost layers are often designated as the "hypoderm," is in the stem located beneath the epidermis and borders inwardly on the mestome-bundles or on the mechanical tissue, supporting these. The cortex contains often ducts and cells with chrystals, and is in not a few instances traversed by aëriferous lacunes of quite considerable width, which prevail in aquatic plants. The cortex in the root occupies the same position, and its innermost layer is here constantly differentiated as an endodermis, bordering on the pericambium. The endodermis of both stem and root differs from the other strata of the cortex by the cells being prismatic and often quite long, by the cell-walls sometimes attaining a prominent thickening, and by the corky substance of the cell-wall.

In many respects the pith resembles the cortex, but is usually of a more regular and uniform structure, as a rule constituting the innermost portion of the central cylinder of stems. Mestome-bundles, ducts, lacunes, and chrystal-bearing cells may also be observed in the pith, but not so frequently as in the cortex.

A tissue corresponding in many respects to the cortex is the chlorophyll-bearing palisade- and pneumatic-tissue in leaves. The cells of the palisade-tissue are very thin-walled, rectangular, and placed vertically on the upper surface of the leaves; they contain chlorophyll in abundance. The pneumatic-tissue is located underneath the palisade-tissue and borders on the epidermis of the lower face of the leaf. It is of a very open structure on account of the frequently very irregular shape of the cells, which may vary from roundish to polyhedric or even stellate, a structure corresponding well with its function and its location near the lower epidermis, where the stomata are most numerous.

These tissues, briefly described above, are the most characteristic ones of plant-organs, but their mutual position in these organs offers not a few variations, hence it will be necessary to present a discussion of their occurrence as constituting the structure of roots, stems, and leaves.

The Anatomy of the Root.— The fact that the root is only slightly susceptible of modification in respect to its external structure is especially expressed by the great uniformity that prevails in its internal structure. Roots, however, are not always quite as uniformly developed as generally described, but very few botanists have paid much attention to their structural peculiarities. Some types of roots have been suggested,— for instance "nutritive," "attachment," "contractile," and "storage," — all of which possess a somewhat modified structure corresponding to their functions. But common to all roots are the following tissues: Epidermis, cortex, pericambium, and the conductive tissue.

The epidermis is as described above, but lacks the cuticle, at least partly, and the only hair-formations that occur here are the long, unicellular root-hairs, observable on nearly all young roots excepting at the apex of these, which is covered by the root-cap. The cortex consists of parenchymatic cells, frequently arranged in regular concentric rings; the outermost strata beneath the epidermis are often differentiated as a more or less thick-walled and persisting hypoderm, while the inner ones are usually thin-walled and liable to collapse radially or tangentially, thus giving rise to wide lacunes. The innermost layer of the cortex differs from all the others and represents the endodermis (*e* in Fig. 9), whose structure offers several excellent characteristics for its distinction from the adjoining cortical parenchyma and the pericambium (*p* in Fig. 5). Such characteristics may be expressed by the different manner in which the cell-walls are thickened, or by the presence of the peculiar dots named after Caspary, which are seldom lacking in thin-walled endodermis-cells. These dots, readily visible in transverse sections, are due to foldings of the cell-wall. Inside the endodermis is a layer, and commonly a single one, of usually thin-walled cells, called the pericambium or the pericycle. This tissue is a most important one, since it is capable of cell-division, and it is in this layer that all lateral roots of phanerogams become developed, and usually also the root-shoots. In ferns the lateral roots do not originate in this tissue, but in the endodermis. The pericambium surrounds the conductive tissue in roots

represented by strands of leptome and hadrome in alternation with each other, sometimes enclosing a central mass of conjunctive tissue, or a wide central vessel. The leptome is not as well differentiated as in the stem, and the vessels are arranged in radial groups of which the outermost are the oldest and generally known as the "proto-hadrome vessels." The position of the proto-hadrome is variable, since it is not unusual to observe some of the vessels bordering on endodermis, having thus broken through the pericambium, a structure not uncommon in grasses and sedges. The normal position of these earliest developed vessels is, however, inside the pericambium. But whatever the position may be of these primordial vessels, the development of the hadrome is in roots constantly centripetal in contrast to the stem; the central arrangement of the conducting elements in the roots offers also an excellent distinction between root- and stem-structure, besides the tangential and alternating position of the leptome and hadrome. It is a well-known fact that roots of trees and certain herbaceous plants increase in thickness. This is due to the development of a cambium, a formative tissue, inside the leptome, but forming an arch outside the proto-hadrome. In general this cambium behaves like that of the stem, forming hadrome inwardly, leptome and mechanical tissue outwardly, thus the structure of such roots becomes exactly like that of a stem unless the central portion is still preserved. For in the root the centre must be occupied by three or more radiating primordial vessels instead of a pith.

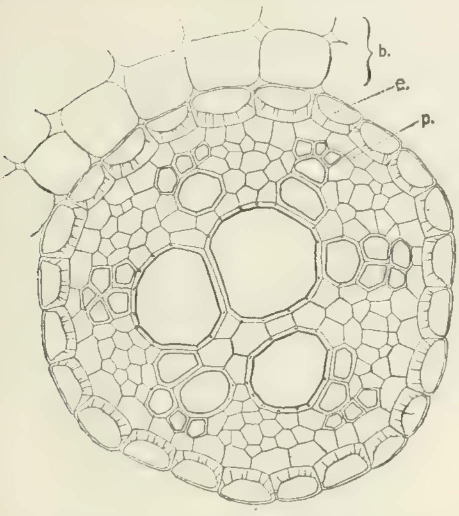


FIG. 9.— Cross-section of the root of *Commelina: b*, the cortex; *e*, endodermis; *p*, the pericambium; the six rays of vessels alternate with six groups of leptome.

The Anatomy of the Stem.— The minor structure of the stem of the above- and underground differs materially from that described as characteristic of normal roots, even if the tissues themselves are much the same. There is an epidermis, a cortex, a mechanical- and conductive-tissue besides a pith, but no pericambium. The stem, however, exhibits a much larger plasticity than the root, and the numerous modifications that occur in respect to the mere external structure are usually accompanied by a corresponding variation in its interior. Marked distinctions are noticeable in stems when we compare the herbaceous with the woody, the annual with the perennial, the terrestrial with the aquatic, and the aërial with the subterranean,— distinctions that have been very extensively studied and have rendered it possible to identify fragments of such stems merely by the aid of the microscope.

When compared with the root, the presence of a pith is characteristic of the stem, while on the other hand a pericambium is observable only in roots. The minor structure of the stem is thus very variable, but may be described more generally as follows: The epidermis consists mostly of a single layer; the outer cell-wall always possesses a more or less distinct cuticle, and the cells may be extended into hairs of very different aspect and functions as already described. When the epidermis is not sufficient to protect the inner tissues,— as, for instance, in perennial stems or such as increase in thickness,— a cork develops either in the epidermis itself or in the cortical parenchyma. The cortex is often prominently represented by numerous layers of parenchymatic tissue in which bundles of stereome and mestome frequently occur, in addition to which lacunes and ducts are commonly observed. The innermost layer of the cortex is usually modified as an endodermis (*End*, in Fig. 10), surrounding the central mass of conductive tissue. The mechanical tissue occurs either as isolated strands or as a partial or complete covering of the mestome-bundles. The arrangement of the mechanical tissue is extremely variable and the monocotyledonous plants are especially instructive in respect to this particular tissue. The conductive tissue represented by the mestome-bundles contains the elements as described above, and most frequently each bundle consists of both leptome and hadrome, usually arranged radially with the leptome as the outermost. A very delicate tissue is observable between both

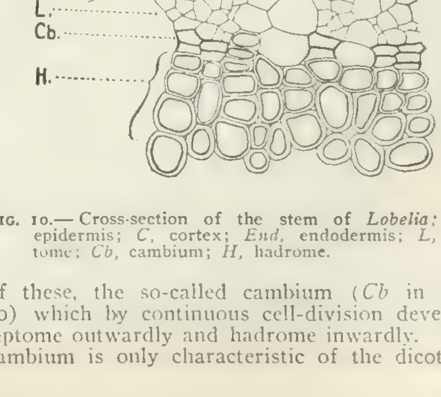


FIG. 10.— Cross-section of the stem of *Lobelia: Ep*, epidermis; *C*, cortex; *End*, endodermis; *L*, leptome; *Cb*, cambium; *H*, hadrome.

of these, the so-called cambium (*Cb* in Fig. 10) which by continuous cell-division develops leptome outwardly and hadrome inwardly. The cambium is only characteristic of the dicotyle-

donous plants. When the cambium occurs between the leptome and the hadrome it is called intrafascicular in contrast to the interfascicular,

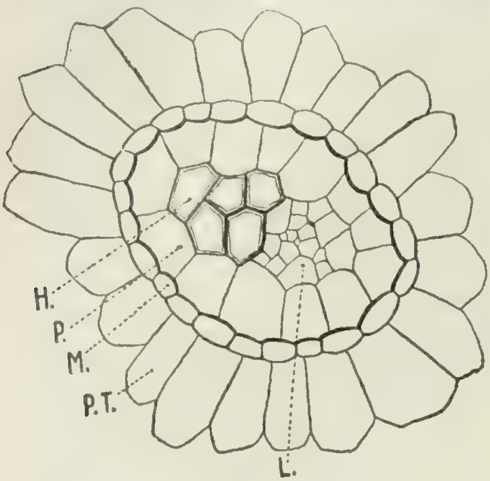


FIG. 11.— Cross-section of the leaf of *Cyperus*, showing a mestome-bundle surrounded by palisade-tissue (*PT*): *M*, the mestome-sheath; *P*, the inner parenchyma-sheath; *H*, the hadrome; *L*, the leptome.

located between the mestome-bundles, thus the cambium in such plants constitutes a closed ring. The mestome-bundles do not always exhibit this radial structure where the leptome is located outside the hadrome, a type that is called collateral (Figs. 11 and 12), but some modified structures have been described, namely the "bicollateral" and the "concentric." The bicollateral are characterized by the presence of leptome on both sides of the hadrome, outside and inside, and this structure has been observed in several of the dicotyledonous orders, for

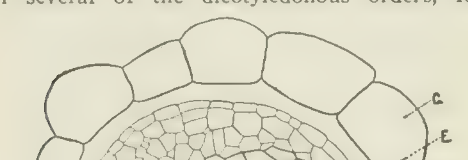


FIG. 12.— Cross-section of a mestome-bundle from the leaf-stalk of a fern (*Polypodium*): *C*, the innermost layer of cortex; *E*, endodermis surrounding the conductive tissue with the vessels in the middle.

instance in the *Cucurbitaceæ* and *Solanaceæ*. The latter type, the concentric, represent a singular arrangement of the leptome and hadrome, the one being surrounded by the other; when the hadrome surrounds the leptome the bundle is called "peri-hadromatic" (Fig. 13), while in the peri-leptomatic bundle the hadrome occupies the central space (Fig. 12). These types of concentric bundles are not so very frequent, but the perihadromatic are, however, quite characteristic of the rhizomes of the majority of the monocotyledons. The perileptomatic bundles are very rare among the phanerogams, but constitute the only form of mestome-bundles in ferns and lycopods.

When we consider the general arrangement of the mestome-bundles in transverse sections of mono- and dicotyledons, we notice a striking difference by the fact that in the former these bundles are scattered without any order, while they form concentric rings in the latter.

While thus these systems of tissues exhibit many variations in the stems, the last tissue, the pith, is almost uniformly developed as a central parenchyma, and as a rule is always

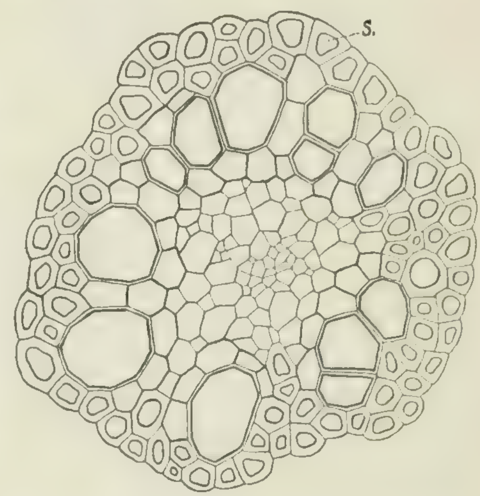


FIG. 13.— Cross-section of a mestome-bundle from the rhizome of a sedge (*Carex incurva*): *S*, the stereome, surrounding the conductive tissue with the leptome in the middle.

present in stems. The thickness of various underground stems, such as tubers, is due to the prominent development either of the pith or of the cortex, in which starch and similar nutritive matters may be stored.

The Anatomy of the Leaf.— The manifold variation exhibited by leaves corresponds also with certain modifications of the internal structure, but to a much less extent than observable in stems. The various functions performed by the leaves do not require such great internal modification as is necessary to the stem, even if the leaves exhibit a metamorphosis of no small importance. The stem-leaves and the floral leaves naturally show conspicuous anatomical distinctions, and the fleshy leaves of bulbs are of course very different in structure from the thin, scale-like leaves of tubers and stolons. However, the principal structure, such as is exhibited by the relative development and arrangement of the main tissues, for instance the mesophyll (the chlorophyll-bearing parenchyma

including the palisade- and the penumatic-tissue), the stereome, and the conductive tissue, is not very variable in leaves when we consider the enormous variation in the shape and size of their outline. In the leaves the epidermis is perhaps the tissue that is subject to the most conspicuous modification, which is especially noticeable in the development of the cells when examined on both surfaces of the leaf, above and between the nerves. The various arrangements of the stomata often cause a modification of the surrounding strata, which is less pronounced in the stems. Thus the epidermis, when examined superficially, exhibits several distinct forms of cells, rectangular, polyhedric, or with the outline very prominently modulate (Fig. 5). The covering with hairs is especially characteristic of leaves, and several types of these may be found to occur on the same leaf. The cuticle is usually very distinct, and renders by its various consistence the most essential protection to the leaf while performing its functions. Besides the epidermis, corky layers may be developed, at least locally, in leaves which

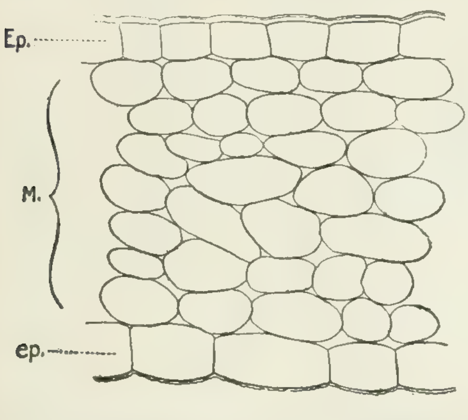


FIG. 14.— Cross-section of the leaf of *Obolaria: Ep*, epidermis of upper surface; *ep*, epidermis of the lower; *M*, the mesophyll.

persist for several seasons; for instance, the evergreen, in which the outer cell-wall of epidermis often becomes very considerably thickened.

The mesophyll is generally differentiated as a palisade- and a pneumatic-tissue, the former located on the upper face of the leaf, just beneath the epidermis, while the latter occupies the lower portion. In some leaves the mesophyll is not differentiated into these two tissues, but only as a homogeneous (Fig. 14) tissue; such leaves are called «isolateral» in contradistinction to the others, the «bifacial.» Otherwise the mesophyll possesses the same forms of reservoirs, ducts, and lacunes as are characteristic of the cortex.

The mestome-bundles are generally collateral with the hadrome located above the leptome, and we find in the leaves the same mechanical support as observed in the stem. But while the mestome-bundles of the stem may show such modifications as «bicollateral» or «concentric,» they lose this peculiarity as soon as they enter the leaves, in which they occur only as collateral.

The leaf-structure thus possesses less variation than that of the stem. if we compare the relative development and the arrangement of the tissues, especially of the mesophyll, the stereome, and the mestome. The main variation seems to lie in the epidermis, and becomes especially noticeable in the comparison of leaves of plants that grow under diverse conditions,— of terrestrial and aquatic plants, for instance. Among the former the desert-plants are known to possess highly complicated structures, which naturally are expressed by the epidermis and the mesophyll rather than by the other elements. But considered as a whole, the leaves show less modification of the inner tissues than the stem, and when some prominent variations are found to occur in leaves these are generally observable also in the stems of the same plants.

The object of the study of plant-anatomy is to ascertain the structure of the various plant-organs, and to bring this in connection with the functions performed by these, thus physiological botany must necessarily be preceded by anatomical studies. But in later years plant-anatomy has been extended still further, and a special branch of this science, «plant-anatomy,» is now recognized as the «anatomical method» by which modifications in structure are brought in connection with the systematic position of the plants. And anatomical investigations have proved that certain precise characteristics do exist in most of the natural orders; thus these, their genera, and in many instances even their species, may be distinguished simply by a few anatomical characters.

This method was founded by the French botanist Mirbel, who was followed, but many years later, by Vesgne and Radlkofer, whose works constitute the real foundation of this particular branch of anatomy. In later years the anatomical method has been studied very extensively, but is of course of less importance than the former, where the structure is brought in connection with physiological problems, the life of the plant under various conditions of environment.

THEO. HOLM,
Expert Botanist, Washington, D. C.

Anaxag'oras, a Greek philosopher: b. in Clazomenæ, in Ionia, about 500 B.C.; d. in Lampsacus, about 428. Settling at Athens, his pupils included Pericles, Euripides, and Socrates. In middle life he was publicly charged with impiety and condemned to death, but the sentence was commuted to perpetual banishment. Anaxagoras held that there was an infinite number of different kinds of elementary atoms, and that these, in themselves motionless and originally existing in a state of chaos, were put in motion by an eternal, immaterial, spiritual, elementary being, from which motion the world was produced.

Anaxarchus, a native of Abdera, who was a friend and counselor of Alexander. He was put to death by Nicocreon, prince of Cyprios.

Anaximan'der, a Greek philosopher, mathematician, and astronomer: b. in Miletus 611 B.C.; d. 547. The substance of his philosophical teaching is that the source of all things is an undefined substance infinite in quantity. According to his theory the universe is a series of concentric cylinders surrounding the cylindrical

earth. Anaximander occupied himself much with mathematics and geography, and to him are ascribed the invention of geographical maps, the first application of the *gnomon* or style fixed on a horizontal plane to determine the solstices and equinoxes, and the discovery of the obliquity of the ecliptic.

Anaximenes of Lampsacus, a Greek historian: b. in Lampsacus, Asia Minor, about 340 B.C. To him is attributed the 'Ars Rhetorica ad Alexandrum' found among the writings of Aristotle. Only fragments of his histories of Philip of Macedon, Alexander, and Greece remain.

Anaximenes of Miletus, a Greek philosopher: b. in Miletus, and flourished about 550 B.C. He affirmed that air was the first principle of all things. Finite things were formed from the infinite air by compression and rarefaction produced by eternally existent motion; and heat and cold resulted from varying degrees of density of the primal element.

Anaya, à-nä'yà, **Pedro Maria,** a Mexican commander: b. in Huichapan 1795; d. 1854. Entering the army in 1811 he attained the rank of brigadier-general in 1833. He held several cabinet positions, was acting president of Mexico for a few weeks in 1847, and at the time of his death was postmaster-general under Santa Anna.

Ancachs, a department of northern Peru, extending from the Andes to the Pacific: capital, Huaraz. Agriculture and cattle-raising are the chief occupations, the silver-mines in the mountains being but ineffectively worked. Area, 17,-405 square miles. Pop. about 429,000.

Ancæus, the name of two of the Greek Argonauts, one the son of Poseidon and steersman of the Argo, the other a son of the Arcadian Lycurgus. Each was killed by a wild boar.

Ancelot, Jacques Arsène François Polycarpe, a French novelist, dramatist, and poet: b. Havre, 9 Feb. 1794; d. Paris, 7 Sept. 1854. His tragedy, 'Louis IX.,' brought him a pension in 1819, but he lost it through the revolution of 1830. He produced pleasing verses, epigrammatic satires; an epic, 'Marie de Brabant' (1825); a novel, 'L'Homme du Monde' (1829), as well as other works, but 'Louis IX' remains his most important achievement. His wife, MARGUERITE VIRGINIE CHARDON, b. Dijon, 15 March 1792; d. Paris, 21 March 1875, wrote novels and plays sometimes with him, but also independently, and won some attention as an artist.

Ancestor, one who has preceded another in a direct line of descent; an ascendant, a former possessor; the person last seised. Termes de la Ley; 2 Shars. Bl. Com. 201. In the common law, the term is understood as well of the immediate parents as of those that are higher; as may appear by the statute, 25 Edw. III., *De natis ultra mare*, by the statute 6 Rich. II. c. 6, and by many others. But the civilians' relations in the ascending line, up to the great-grandfather's parents, and those above them, they term *majores*, which common lawyers aptly expound *antecessors* or ancestors, for in the descendants of like degree they are called *posteriores*. Cary, Litt. 45. The term ancestor is applied to natural persons. The words predecessors and successors are used in respect to the persons composing a body corporate. See 2 Bl. Com. 209; Bacon, Abr.; Ayliffe, Pand. 58; Reeve, Descents.

Ancestor-Worship. See MAN.

Anchieta, àn-shyä-tà, **Jose de,** a Portuguese missionary in Brazil: b. Laguna, Teneriffe, 1533; d. 1597. He was a Jesuit and founded in Brazil the first institution for the conversion of the inhabitants. He was the author of 'Natural Productions of Brazil.'

Anchisaurus, a carnivorous dinosaur of the Triassic period. It has many primitive characteristics, notably small size, four complete toes in the hind foot and five in the fore foot.

Anchises, a legendary hero of Troy, to whom Venus, in the guise of a Phrygian shepherdess, bore a son, Æneas. At the burning of Troy Æneas carried his father away on his shoulders, and their voyage to Sicily is described in Virgil's 'Æneid.'

Anchitherium. See FOSSIL; HORSE.

Anchor, a heavy instrument of iron, intended to be dropped from a ship to the sea-bottom, to hold her in a desired position. It usually consists of a shank, having at one end a ring, to which the cable is fastened with a cross-piece or stock, and at the other end two arms with blades at the end, called flukes. In one form of anchor the stock is not a cross-piece in the sense of lying transversely to the direction of the arms, but lies in the same direction. In the Homeric times large stones were used for anchors; afterward they are said to have been sometimes of wood loaded with lead. In some places baskets full of stones or sacks filled with sand were employed for the same use. All these were let down by cords into the sea, and by their weight stayed the course of the ship. Among the Greeks of later times anchors were composed of iron. Sometimes there was only one tooth or fluke, but generally there were two. Anchors with two flukes appear from ancient monuments to have been much the same as those used as present, but the transverse piece of wood fastened to the shank (the stock) is wanting in all of them. Every ship had several anchors, one of which, surpassing all the rest in bigness and strength, was peculiarly termed, in Greek, *hiera*, and in Latin *sacra*, and was never used but in extreme danger; whence *sacram ancoram solvere* is proverbially applied to such as are forced to their last refuge. When an anchor of the usual form is let fall from the vessel, it generally strikes the bottom with the crown or curve of the arms, and then falls over on one of the ends of the stock, the arms lying flat on the ground. In this position it cannot bite, so that it has to be canted or turned over till the stock lies flat, and the point of one of the flukes (the bill or peak) rests on the ground. The canting is effected by the vessel pulling at the cable, and the longer the stock and the shorter the arms the less is the force required to perform the operation; for this reason the stock is always made longer than the arms. The anchor will now either drag or penetrate the ground, the readiness with which it does the latter depending on the sharpness of the bill, the angle at which the fluke rests on the ground, and of course the nature of the bottom. Formerly the arms used to be rigidly at-

tached to the shank of the anchor; but in 1838 Mr. Porter took out a patent for an anchor of a new construction (though the principle was known before, however), in which the arms were movable around a pivot at the end of the shank, the plane of their movement being perpendicular to the direction of the stock. The advantages of this anchor are, that there is almost no possibility of fouling it,— that is, of the cable becoming entangled with one of the arms; it cannot lodge on the stock end; it presents no upper fluke to injure the vessel to which it is attached, or others, in shoal water (since the swivel movement enables the peak of the upper fluke to come close to the shank when the anchor is fixed); it is not so liable to break, is more conveniently stowed on board, etc. This form of anchor as improved by Trotman is now largely used in the merchant service. In the navies both of Great Britain and of foreign countries the anchor perhaps most commonly employed is the admiralty anchor with fixed arms, the chief recommendation of which is the excellence of its proportions. Another favorite is Rodgers', the chief peculiarity of which is its small flukes. The inventor claims for this anchor that it holds the ground better than those with large flukes. Another excellent anchor is that patented by a Frenchman named Martin. In his anchor the stock lies in the same direction as the arms, the consequence of which is that when the anchor reaches the ground it inevitably falls flat, with both stock and arms resting on the bottom. The arms are capable of turning in a socket through an angle of 30° in such a manner that when the anchor is lying flat on the ground the flukes of both arms may sink into the ground at an angle of 15°. The weight of the arms and the pull of the vessel cause them to do this. It will be understood that the flukes are not, as in other anchors, perpendicular to the direction of the arms, but lie in the same direction. Besides holding the ground more firmly than any other anchor of equal weight, this anchor has the advantages of being free from liability to foul and easily stowed. The latter circumstance particularly recommends it for use in unmasted turret ships, almost all of which are equipped with it.

The different anchors carried by a ship are called bower, sheet, stern, and kedge anchors. The bower anchors are so called from their being stowed in the bow. When one bower anchor is heavier than the other it is called the best bower and is stowed on the starboard side. Sheet anchors are stowed in the waist of the ship as far forward as convenient. The stream anchor is used in a river or sheltered place where a large anchor is not required. The stern anchor is stowed in the stern, and is employed with a bower anchor where there is no room for a vessel to swing with the tide. The kedge anchor is used to warp a ship from place to place; that is, the anchor is carried to a distance in a boat, and the ship is then pulled up to it by means of the cable. A large ironclad carries eight anchors: two bower, two sheet, and two kedge anchors, with one stream and one stern anchor. The anchor is said to be a-peak when the cable is perpendicular between the hawse and the anchor; and to come home when it does not hold the ship. To shoe an anchor is to fix boards upon the flukes so that it may hold better in a soft bottom. Riding at anchor is the state of the vessel when moored by the anchor or anchors. Dropping or casting anchor is letting it down into the sea. Weighing anchor is raising it from the bottom. A mooring anchor is a stationary anchor in a harbor or roadstead, with a buoy attached to it by a cable, enabling a ship to moor by simply fastening itself to a ring-bolt on the buoy. These anchors should not project above the bottom, or the ship may receive injury by grounding on them. Mooring anchors are of various kinds, and in some cases a heavy block of stone or cast iron serves as such. One of the most powerful mooring anchors yet invented consists of a wrought-iron shaft with a pointed screw end, and near the lower end a cast-iron screw flange 3½ feet in diameter. The anchor is screwed down into the solid ground, and its holding power is more than equal to that of a cast iron anchor weighing 7 tons. The making of anchors used to be a most formidable piece of smith work, but it has been much facilitated by the invention of the steam hammer. The shank of a large anchor, nearly 20 feet long and 10 or 12 inches thick, requires to be built up of a number of bars of iron which are then welded together. Crucible steel is now to some extent used for anchors.

Anchorage, a suitable place for anchoring. A good anchorage should have a soft bottom and a depth of from 10 to 20 fathoms. When deeper than this the cable bears too nearly perpendicular and is apt to drag up the anchor. The length of cable paid out by a ship in anchoring in ordinary weather is about three times the depth of the water. Anchorage also means dues paid by a vessel anchoring. As a rule a ship sheltering from stress of weather and not discharging cargo at the place where it anchors is not required to pay dues, but shore-dues are payable whether a ship anchors or not.

Anchorite, Anchoret, or **Anachoret,** one who has renounced the world and retired into a seclusion remote from inhabited places. The desire is not distinctively Christian: it manifests itself in all religions and in all ages. Anchorites of various Hindu ascetic sects are at present to be found among the jungles and hills of India, and the Orient has always been a land of them. The peculiarity of the ancient anchorites was that, though retiring for solitude to the wilderness, they lived there in fixed abodes, generally caves or hovels, in place of wandering about. When they did travel they slept wherever night overtook them, so that visitors might not know where to find them. They were most numerous in the Egyptian desert, where they lived on roots and plants, believing that to afflict the body was the best method of spiritually benefiting the soul. The most of them were laymen. There were also female anchorites. These first arose, it is said, about the middle of the 3d century; in the 7th the Church extended its control over them, ultimately throwing difficulties in the way of anyone who wished to adopt such a mode of life.

Anchovy, an-cho'vi (of uncertain origin, perhaps literally a dried or pickled fish, from Basque, *antzua*, dry), a small, richly flavored, herring-like fish (*Engraulis encrasicholus*), of the family *Engraulididæ*. It is caught abundant-

ly along the sea-coasts of southern Europe when coming in from the deep sea to spawn in early summer. The Mediterranean fishers in particular salt and dry it in large quantities for export. Closely allied species are found on the eastern and western coast of America and off southern Asia. A Californian species (*Engraulis mordax*) is extremely abundant in large schools and is a valuable food fish. In general, anchovies are 5 to 7 inches long, shaped like herrings, and have a pointed head and projecting upper jaw.

Anchovy-pear (*Grias cauliflora*), a tree of the natural order *Myrtaceæ*, found in moist districts of the West Indies. It grows to the height of 50 feet, has oblong leaves 2 or 3 feet long, and large white blossoms carried on short peduncles. Its fruit, somewhat larger than a hen's egg, is pickled and eaten like the mango, which it strongly resembles in taste.

Anchusa. See ALKANET.

Anchylosis, ăn-kĭ-lō'sĭs. See JOINTS.

An'chylo'stomiasis, a disease due to the presence of an intestinal parasite, the *Anchylostomum duodenale* (*Uncinaria duodenalis*). This parasite lives in the upper portion of the small intestine, where, by means of a series of tooth-like hooks about the mouth, it attaches itself to the mucous membrane. It is particularly prevalent among Italian and Polish laborers, especially among those who work in confined spaces, as mines, tunnels, etc.

The chief symptoms are those due to the loss of blood which the worm constantly sucks from the wall of the intestine. Gastro-intestinal disturbance, progressive anæmia, diarrhœa, and colicky pains with shortness of breath and swelling of the limbs are among the important symptoms. The diagnosis can be made by means of a microscopical examination of the fæces, in which the eggs are found, and also by the microscopical examination of the blood. Careful attention given to the drinking water is one of the most important prophylactic measures. See PARASITE.

Ancient Demesne, a term employed in English law to denote ancient estates belonging to the crown. They are mentioned in Domesday Book as *Terræ Regis*.

Ancient Lights, a term denoting windows so long existent that they have obtained a right to the light entering them, and cannot be interfered with by the owner of the property whence the light enters. Rights of this nature cannot commonly be acquired by prescription in the United States. Ancient lights in England are now regulated by a statute calling for but 20 years' existence to create the right.

Ancient Mariner, Rime of the, a celebrated poem (1817) by Samuel Taylor Coleridge. It is one of the most original poems in the English language. A wedding guest on his way to bridal festivities is stopped by an old man, the Ancient Mariner. The Ancient Mariner describes his voyage, how his ship was locked in the ice, and how he shot with his cross-bow the tame albatross, the bird of good omen which perched upon the vessel. The entire universe seemed stunned by this wanton act of cruelty; and the albatross is hung around the neck of the Ancient Mariner. A spectre ship appears, and the crew die, leaving the graybeard alone. After a time he is moved to prayer, whereupon the evil spell is removed. The albatross sinks into the sea, and the Mariner's heart is once again a part of the universal spirit of love. The weird ballad is capable of many interpretations, and in its small compass it contains a tragedy of remorse and of redemption through repentance.

Ancient Order of Hibernians. See HIBERNIANS, ANCIENT ORDER OF.

Ancient Régime, The, an historical work by H. A. Taine (1875), a masterly study of the France which, after 1,200 years of development, existed in 1789, of great value for the history of France and for judgment of the future of the French Republic. Taine's brilliant style and picturesque narrative, his philosophical contemplation of data, and his keen reasoning, have never been more strikingly exhibited than here.

Ancient Rome in the Light of Recent Discoveries, an archæological work by Rodolfo Lanciani: b. 1847. In his character of official investigator Prof. Lanciani has grouped in this volume various illustrations of the life of ancient Rome as shown in its recovered antiquities. From these he reads the story of the wealth, taste, habits of life, ambitions, and ideals of a vanished people.

Ancients, Council of, the upper one of two branches of the legislative body of France, 1795–99. It included 250 members and its function was to consider measures submitted by the lower branch, the Council of Five Hundred.

Ancile, a shield reported to have fallen from heaven in the time of Numa. It was believed to be the shield of Mars; and as the prosperity of Rome was held to depend upon its preservation, 11 facsimiles of it were made, that anyone wishing to steal it might not know which to take. It is conjectured to have been originally a lump of meteoric iron.

Ancillon, än'sē'yon, **Johann Peter Friedrich,** a German historian of French extraction: b. Berlin, 30 April 1767; d. there, 19 April 1837. Besides 'Mélanges of Literature and Philosophy' (1801) he was the author of a 'View of the Revolutions of the Political System of Europe since the 15th Century' (1803–5), which secured him the post of royal historiographer. From 1832 till his death he was minister of foreign affairs.

Ancona, Allessandro d', a prominent Italian critic and philologist: b. Pisa, 1835, and from 1860 a professor of literature in the University of Pisa. Among his many works are 'I Precursori di Dante' (1874); 'Origini del Teatro in Italia' (1877); 'La Poesia Popolare Italiana' (1878); 'Varietà Storiche e Lettarie' (1883–5); 'Studi sulla Letteratura Italiana de' Primi Secoli' (1884).

Ancona, an Italian province of the kingdom of Italy, between Pesaro ed Urbino on the north, Macerata on the south, and the Apennines and Adriatic on the west and east; area, 736 square miles. It is a mountainous region watered by the rivers Cesano, Esino, and Musone, and produces grain, wine, oil, olives, silk, and fruit. Capital, Ancona. Pop. (1894) 273,941.

Ancona, an important Italian port on the Adriatic, the capital of the province of the same name. Its site is an amphitheatre between two headlands, and on its ancient mole, designed by Trajan, is a triumphal arch by Apollodorus. The modern mole is adorned by a triumphal arch by Vanvitelli. Among important buildings are the cathedral of St. Cyriac dating from the 11th and 12th centuries, a 13th-century town hall, and a museum. Sugar-refining, ship-building, and manufactures of silk, paper, and sail-cloth are the main industries. A United States consul is stationed here. The city is said to have been founded by Syracusans fleeing from the persecutions of the Elder Dionysius. Pop. (1901) 57,000.

Ancre, äɴ'kr, **Concino Concini, Marshal and Marquis d',** a Florentine who went to France in 1660, where he obtained rapid promotion, more especially after the assassination of the king (1610). Successively governor of Normandy, marshal of France, and last of all prime minister, he was thoroughly detested by all. At last a conspiracy was formed against him and he was shot dead on the bridge of the Louvre in 1617.

Ancud, a Chilian port, capital of the province of Chiloe. It is situated on the island of Chiloe, about 580 miles from Valparaiso, a line of steamships connecting the two. First settled in 1768, it was the last place surrendered by the Spaniards to the Chilians in 1826. Pop. (1895) 3,182.

Ancus Marcius, the fourth king of Rome: b. 638 B.C.; d. 614 B.C. The son of Numa's daughter, he attempted to imitate his grandfather by reviving the neglected observances of religion. His peaceful pursuits were disturbed by the Latins, whom he subdued and caused to be brought to Rome, where he assigned them the Aventine to dwell upon. These conquered Latins, according to Niebuhr, formed the original *plebs.* He fortified the Janiculum against Etruria, connecting it with the city by the wooden bridge across the Tiber known as the Sublician; dug the ditch of the Quirites; constructed the harbor of Ostia; and built the first Roman prison of which there is any record.

Ancy'ra. See ANGORA.

An'da, a genus of plants of the natural order *Euphorbiaceæ.* The *A. brasiliensis,* the single species, is an inhabitant of Brazil. The wood is spongy and light, the flower yellow and large, and the fruit a gray nut which encloses two kernels in a double rind. The fruit is strongly purgative and is used by Brazilians as a remedy in cases of indigestion, jaundice, and other diseases. Oil is pressed from these kernels, with which the natives anoint their limbs. It is said to be a good drying oil and excellent for painting. The rinds of the fruit, thrown into ponds, destroy the fish.

Andalusia, ăn'dȧ-lōō'zĭ-ȧ (Spanish, *Andalucia*), a district of southern Spain, celebrated for its fertility and picturesque beauty; bounded north by Estremadura and New Castile, east by Murcia, south by the Mediterranean Sea, and west by Portugal and the Atlantic. Length east and west about 310 miles; average breadth about 120; area about 33,650 square miles. It is traversed throughout its extent by ranges of mountains. The Sierra Morena runs along its northern border, and in the southeast rise the mountains of Granada and the Ronda, including numerous sierras, and among them those of the famous Sierra Nevada. Many summits of the latter ranges are covered with perpetual snow; the Mulahacen rising 11,678 feet, and the Picacho de Veleta 11,378 feet above the sea. All the mountains abound with mineral wealth, yielding chiefly copper, cinnabar, and lead, as well as some silver, copper, and coal. Mines have been opened recently by English companies, especially in the province of Huelva in the west, where the Tharsis and Rio Tinto copper mines are situated. The principal river of Andalusia is the Guadalquivir, which rises in the east part of the province of Jaen, near Carzola, and thence flows west-southwest, and below Seville south-southwest, entering the sea at San Lucar. Its principal affluents are the Guadalimar, Guadiato, and Xenil. The rivers south of the Sierra Nevada are quite insignificant. The basin of the upper Guadalquivir lies at an elevation of from 500 to 1,500 feet, and consists mainly of saline wastes and other sterile tracts. The lower basin presents sharp contrasts: around Cordova and Seville luxuriant gardens; on the Xenil a desert without a drop of water; on the left bank of the lower Guadalquivir the extensive marshy district of Marisma; and stretching from the mouth of the Guadalquivir to that of the Rio Tinto, a sandy depression (Arenas Gordas) partially clothed with pine-woods. The vegetation is of the character peculiar to the extreme south of Europe and the north of Africa. Wheat, maize, barley, many varieties of fruit, grapes, honey, silk, and cochineal form important articles of culture. A large portion of the soil is in pasture. The horses are the best breed in the Peninsula; the bulls of Andalusia are sought for bull-fighting over all Spain; sheep are reared in vast numbers, and bear an abundance of good but not fine wool; and the hogs reared on the acorns of the mountain forests furnish hams unsurpassed in any part of Europe. The chief manufactures are woolens, silk, and leather, and are by no means extensive. The name Andalusia is commonly taken to have been originally Vandalusia, the land of the Vandals. The population was in 1897 about 4,000,000.

Andalu'site, a native anhydrous silicate of aluminum, first discovered in Andalusia. Its chemical formula is Al_2SiO_5, and it crystallizes in the orthorhombic system. It usually occurs in coarse crystals, prismatic in form, and nearly square. Its hardness is 7.5, at least on the basal face, and its specific gravity about 3.18. Andalusite is commonly subtranslucent and varies greatly in color. Some specimens are strongly pleochroic, changing from olive green to blood red according to the angle at which the incident light strikes them. A variety known as chiastolite contains carbonaceous impurities distributed through the prismatic crystal according to a definite geometric plan, so that a transverse section of the crystal presents a curious tesselated or cruciform appearance. A variety from eastern Finland has been called «maltesite,» from the regularity of the Maltese cross it exhibits when seen in section. Andalusite is found in many parts of Europe, usually in schist or gneiss. Fine specimens also come from the province of Minas Geraes, Brazil. In the Unit-

ed States it occurs in Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Pennsylvania, South Dakota, and California.

Andamans, ăn'dá-manz, a chain of volcanic lands on the east side of the Bay of Bengal, consisting of four principal islands called the North, Middle, South and Little Andamans, with a number of islets. Middle Andaman, the largest, is about 50 miles long and 15 or 16 miles broad. North and South Andaman are each about 44 miles long, and the former has near its east coast a mountain called Saddle Peak, about 2,400 feet high. The vegetation on the islands is very luxuriant — so much so as to render parts almost impenetrable. The aborigines, about 10,000 in number, are small (generally much less than 5 feet), well formed, and active, skilful in the use of the bow and in the management of their canoes, and excellent swimmers and divers. These islands have been occupied since 1858 as a penal colony by the British government of India, the settlement being at Port Blair on South Andaman. Here cultivation has been introduced, rice, coffee, nutmegs, etc., being grown, and the neighboring hills now afford pasturage for numerous cattle. A good deal of thoroughly cleared land has been given over to ticket-of-leave men to cultivate. The coffee produced is very well flavored, fruits thrive excellently, and the pineapples of Port Blair have already a good reputation in India. Edible birds' nests are found in large numbers. The natives in the vicinity of the settlement have been taken under the protection of the government, and have become to some extent civilized. The climate is moist, but fairly healthy. Area, 2,700 square miles. Pop. of Port Blair settlement (1902) about 20,000, of which four fifths are convicts.

Andersen, ăn'der-sen, **Hans Christian,** a Danish novelist, poet, and writer of fairy tales: b. in Odense, 2 April 1805; d. Copenhagen, 4 Aug. 1875. He learned to read and write in a charity school, whence he was taken when only nine years old, and was put to work in a manufactory in order that his earnings might assist his widowed mother. In his leisure time he eagerly read national ballads, poetry, and plays, and wrote several tragedies which he failed to get accepted. His abilities at last brought him under the notice of Councilor Collin, a man of considerable influence, who procured for him free entrance into a government school at Slagelse. From this school he was transferred to the university and soon became favorably known by his poems. His first considerable work, 'A Journey on Foot from Holmen's Canal to the East Point of Anger,' was published in 1828, the year of his admission to the university. Through the influence of Oehlenschläger and others he received a royal grant to enable him to travel, and in 1833 he visited Italy, his impressions of which he published in 'The Improvisatoren' (1835), a work which rendered his fame European. The scene of his following novel, 'O. T.,' was laid in Denmark, and in 'Only a Fiddler' he described his own early struggles. In 1853 appeared the first volume of his 'Fairy Tales,' of which successive volumes continued to be published year by year at Christmas, and which have been the most popular and widespread of his books. Among his other works are 'Picture-books without Pictures,' 'A Poet's Bazaar,' and a number of dramas. In 1845 he received an annuity from the government. He visited England in 1848 and acquired such a command of the language that his next work, 'The Two Baronesses,' was written in English. In 1853 he published an autobiography under the title, 'My Life's Romance,' an English translation of which, published in 1871, contained additional chapters by the author, bringing the narrative to 1867. Among his later works are, 'In Sweden' (1849); 'To Be or Not to Be' (1857); 'Tales from Jutland' (1859); 'The Sand-hills of Jutland' (1860); 'The Ice Maiden' (1863); 'In Spain' (1863).

Anderson, Edwin Hatfield, American librarian: b. Zionsville, Ind., 27 Sept. 1861. He was graduated from Wabash College 1883; librarian Carnegie Free Library, Braddock, Pa., for three years; organized and became first librarian of Carnegie Library, Pittsburg, 1895. He is the author of numerous papers on library economy in 'Library Journal.'

Anderson, George B., an American Confederate soldier: b. Wilmington, N. C., 1831; d. 16 Oct. 1862. He was graduated from West Point in 1852, and in 1855 obtained his commission as first lieutenant in the United States army, and served as regimental adjutant after 1858. Entering the Confederate service in 1861, he was made a brigadier-general and placed in command of the North Carolina coast defenses. While leading a brigade at the battle of Antietam, 17 Sept. 1862, he received the wound which caused his death.

Anderson, Henry John, an American educator: b. New York, 6 Feb. 1799; d. Lahore, Hindustan, 19 Oct. 1875. Was graduated from Columbia College, 1818; M.D. College of Physicians and Surgeons, 1823. Professor of mathematics and astronomy at Columbia, 1825-50; trustee 1851, and professor emeritus 1866; geologist to the Dead Sea expedition under Lieut. Lynch; member of the scientific expedition to observe the transit of Venus, 1873. He died while exploring the Himalayas. He early became converted to the Catholic faith and was active in promoting its interests in New York city. The United States government published his 'Geology of the Expedition to the Dead Sea' (1848).

Anderson, James, a Scottish agricultural economist: b. Hermiston, in Midlothian, Scotland, 1739; d. Isleworth, 1808. When scarcely 20 years of age he invented the small two-horse plow without wheels, known as the Scotch plow. Four years later he left Hermiston and rented a large moorland farm of 1,300 acres in Aberdeenshire, where he devoted his leisure hours to writing on agricultural subjects, his first production being a series of essays on planting contributed to the 'Edinburgh Weekly Magazine.' His principal works are, 'Encouragement of the National Fisheries'; 'An Inquiry into the Nature of Corn Laws'; 'Observations on Slavery,' and 'Recreations in Agriculture, Natural History, Arts, and Miscellaneous Literature' (1799-1802).

Anderson, John, a Scottish philosopher, founder of Anderson College, Glasgow: b. Roseneath, Dumbartonshire, 1726; d. 1796. He stud-

ied at the University of Glasgow, where he was afterward professor of Oriental languages, and later of natural philosophy. In addition to his usual class in physics he instituted one for artisans, which he continued to conduct to the end of his life. In 1786 appeared his 'Institutes of Physics,' which went through five editions in 10 years. He invented a gun whose recoil was stopped by air condensation; but having in vain endeavored to attract the attention of the British government to it, he went to Paris in 1791 and presented his model to the National Convention. It was hung up in their hall with this inscription over it, "The Gift of Science to Liberty." When the allies had drawn a military cordon around the frontiers of France Anderson suggested the expedient, which was adopted, of making small paper balloons, to which newspapers and manifestos were fastened and carried to Germany. Anderson by his will directed that his entire effects should be devoted to the establishment of an educational institution in Glasgow for the use of the unacademical classes. This college, opened with a single course of lectures, has now nearly 20 professors and lecturers; courses of instruction are given in physical and medical science and in chemistry; mathematics, Latin, Greek, Hebrew, French, music, etc., are also taught. As a school of medicine in particular it possesses a high reputation.

Anderson, John, Scotch physician and scientist: b. Edinburgh, 4 Oct. 1833; d. 1900. He obtained his medical degree at the University of Edinburgh, in 1862, and three years later was appointed superintendent of the Indian Museum at Calcutta, and was called to the chair of Comparative Anatomy in the Calcutta Medical College. In 1868–69 and again in 1874–75 he accompanied expeditions to western China as scientific officer. In 1881 the trustees of the Indian Museum commissioned him to investigate the marine zoölogy of the Mergui archipelago, the results of his researches being published in 'Fauna of Mergui and its Archipelago' (1889); and also in the *Journal* of the Linnæan Society (vols. XXI and XXII). In 1887 he retired from the service of the Indian Government. Among his writings, which are mainly reports to the government and scientific papers, the most noteworthy are: 'Mandalay to Momien' (1875); 'Anatomical and Zoölogical Researches' (1878); 'Two Expeditions to Western China' (1876); 'Herpetology of Arabia,' also containing a list of Egyptian reptiles and batrachians (1896); 'Handbook of the Archæological Collections in the Indian Museum;' 'Catalogue of the Mammalia in the Indian Museum,' etc.

Anderson, John Jacob, an American author and educator: b. New York, 30 Sept. 1821; d. 14 March 1906. Graduated at Normal School, College of City of New York, 1846. Teacher for 30 years in public schools of New York city; traveled over North and Central America, Europe, and Africa. He published a large number of text-books on history, chief of which are: 'Manual of General History' (1867); 'School History of the United States' (1868); 'Manual of Mediæval and Modern History'; 'History of France' (1877); 'Complete Course in History, Part 1' (1881).

Anderson, Larz, an American diplomat: b. Paris, France, 15 Aug. 1866; d. 1902. Graduated at Harvard, 1888; second secretary United States legation, London, 1891–3; first secretary, Rome, 1893–7; assistant adjutant general, United States Volunteers, during the Spanish-American war, 1898.

Anderson, Martin Brewer, an American educator: b. in Brunswick, Me., 12 Feb. 1815; d. 26 Feb. 1890; was graduated at Waterville College, now Colby University, in 1840; became professor of rhetoric and organized and taught the course in modern history at Waterville; and was president of the University of Rochester, N. Y., 1853 to 1888.

Anderson, Mary Antoinette, American actress: b. Sacramento, Cal., 28 July 1859. She was educated at the Ursuline Convent and the Academy of the Presentation Nuns in Louisville, and when 13 years of age began to study for the stage. She first appeared at Louisville on 27 Nov. 1875, in the character of Juliet. Her success was immediate, and during the following years she played with increasing popularity in the principal cities of the United States in various roles. In 1883 she appeared at the Lyceum Theatre in London and opened the Memorial Theatre at Stratford-on-Avon in the character of Rosalind in 'As You Like It,' and speedily became well known in England. At the age of 28 she married Antonio de Navarro and retired from the stage. In 1896 she published a volume entitled, 'A Few Memories.'

Anderson, Melville Best, American educator and author: b. Kalamazoo, Mich., 28 March 1851. He was educated at Cornell University (1870–74); the University of Göttingen (1875–76); and at the University of Paris (1876–77). Returning to the United States he occupied several professorships in some of the principal colleges, notably Butler University, Purdue University, the State University of Iowa, and in 1891 became professor of literature in Leland Stanford, Jr. University, which chair he has since occupied. He has translated and edited 'Paul and Virginia'; Hugo's 'William Shakespeare'; Boissier's 'Mme. de Sévigné'; Caro's 'George Sand'; Simon's 'Victor Cousin'; Sorel's 'Montesquieu'; Say's 'Turgot'; Rémusat's 'Thiers'; Joutel's 'Journal of La Salle's Last Voyage' (1896); Tonty's 'Relation' (1898); 'Nicholas de La Salle's Narrative' (1898); 'Cavalier de La Salle's Discovery of the Mississippi River' (1901), etc. He also edited 'Bacon's Essays, with Introduction and Notes' (1890); and wrote 'Representative Poets of the Nineteenth Century' (1896).

Anderson, Rasmus Bjorn, an American author: b. Albion, Wis., 12 Jan. 1846. Graduated at Luther College, Iowa, 1866, and University of Wisconsin, 1869. Professor of Scandinavian languages and literatures in University of Wisconsin, 1875–83; United States minister to Denmark, 1885–9. Author of 'America Not Discovered by Columbus' (1874); 'Norse' Mythology' (1875); 'Viking Tales of the North (1876); translator of Horn's 'History of the Literature of the Scandinavian North' (1884), of various stories by Björnson, 'The Younger Eddas' (1880), and G. Brandes' 'Eminent Authors of the 19th Century' (1886).

Anderson, Richard Henry, an American Confederate soldier: b. South Carolina, 7 Oct. 1821; d. Beaufort, S. C., 20 Feb. 1879. Graduated from West Point in 1842; served in Mexican war. In May 1861 he resigned from the United States army to join the Confederate service. He assisted in the bombardment of Fort Sumter and distinguished himself for gallantry throughout the war, especially at Fair Oaks, Gaines Mills, Frazier's Farm, Bull Run, and Gettysburg. He had the rank of major-general (1862) and lieutenant-general (1864), commanding the 4th corps of Lee's army in the last campaign.

Anderson, Robert, Scotch biographer and critic: b. Carnwath, Lanarkshire, 7 Jan. 1750; d. 20 Feb. 1830. In 1784 he became a resident and practitioner in Edinburgh, but soon after his marriage turned his attention to literary pursuits and finally ceased the practice of medicine altogether. He became editor of the 'Edinburgh Magazine,' wrote a 'Life of Dr. Johnson,' and published 'A Complete Edition of the Poets of Great Britain, with Prefaces Biographical and Critical' (14 vols. 1792–1807).

Anderson, Robert, an American soldier: b. near Louisville, Ky., 14 June 1805; d. in France, 26 Oct. 1871. Graduating at West Point 1825, he entered the artillery as second lieutenant. He was on Scott's staff in the Seminole war, 1837–8; in the Mexican war was badly wounded at Molino del Rey. Commissioned major in 1857, in 1860 he was given command of the troops in Charleston harbor, with headquarters at Fort Moultrie. Threatened with attack, the fort untenable, and the Buchanan administration making no reply to his appeals for its strengthening or for instructions, on 26 December he removed the garrison to Fort Sumter. An attempt of the government to provision it being assumed by the Confederates as a declaration of war, they invested it and compelled its surrender by a bombardment, 12–13 April 1861; its commander leaving with the honors of war. Appointed brigadier-general, he was assigned to the department of the Cumberland; but his health failing, he was relieved from active duty in October and retired in 1863. Brevetted major-general in 1865, in 1869 he went to Nice, France, for his health. He wrote works on tactics, and was instrumental in organizing the Soldiers' Home at Washington.

Anderson, Sir Robert, an Irish barrister and author: b. 29 May 1841. He was assistant commissioner of police in London, 1888–1901, and was knighted in the year last named. His published works include 'The Coming Prince'; 'A Doubter's Doubts about Science and Religion'; 'Human Destiny'; 'The Gospel and its Ministry'; 'Daniel in the Critics' Den'; 'The Silence of God' (1897); 'The Buddha of 'Christendom' (1899); 'The Bible and Modern Criticism' (1902).

Anderson, Rufus, American Congregational clergyman, and Secretary of the American Board of Foreign Missions: b. North Yarmouth, Me., 17 Aug. 1796; d. Boston, Mass., 30 May 1880. Having graduated at Bowdoin College in 1818, he studied theology at the Andover Theological Seminary, completing his course in 1822. In 1824 he became assistant secretary to the Board of Foreign Missions, serving as such till 1832, when he became full secretary. In this position he continued for 34 years, till 1866, when owing to his advanced age and failing health he retired. He inspected the missions in the Mediterranean in 1828–29 and again in 1843–44, the results of his tours of these years being chronicled in his 'Observations on the Peloponnesus and Greek Islands' (Boston, 1830). He also visited the Indian Missions in 1854–55, and the Sandwich Islands in 1863. From 1867 to 1869 he was lecturer on Foreign Missions in the Andover Theological Seminary. He with others founded the Mount Holyoke Female Seminary, at South Hadley, Mass., was for several years president of the board of trustees of Bradford Academy, Mass., and a member of the board of trustees of the Andover Theological Seminary. Besides his 'Observations' he also wrote: 'The Hawaiian Islands, Their Progress and Condition under Missionary Labors' (1864); 'A Heathen Nation Civilized'; 'A History of the Sandwich Islands' Missions' (1870); 'History of the Missions of the American Board of Commissioners for Foreign Missions to the Oriental Churches' (3 vols., 1872–4), etc.

Anderson, Ind., city and county-seat of Madison County; on the White River, 36 miles northeast of Indianapolis. It is the junction of four steam railroads, trunk lines, and is the centre of one of the most extensive systems of electric traction lines in the middle west. The power house is the largest in the State, generating the power which carries cars to every important city in northern and central Indiana.

Industries.—Anderson lies in the centre of a rich agricultural region and is also an important manufacturing centre. Here was established one of the first and largest tin plate mills, introducing that industry into the United States. Over 100 shops are engaged in industrial enterprises where nearly every commodity known to trade is made. Chief among these are tin plate, glass, wire fence, steel springs, nails, automobiles, carriages, shovels, files, wind pumps, steel tanks, shovel handles, carriage and buggy materials, tools and tool workers' supplies, encaustic tiles, etc. Natural gas was discovered in 1887, and while the flow has diminished to some extent it is still sufficient in supply for heating and small manufacturing purposes.

Banks, Public Works, Buildings, Etc.— The city has five banks, with a capitalization of $1,500,000, and deposits of $3,000,000; three daily papers; a city electric railway covering over 10 miles; 20 miles of brick paved streets; 50 miles of cement sidewalk; an excellent fire department, and owns and operates its own water and electric lighting plants. Among the prominent buildings are the Court House, erected in 1882 at a cost of $200,000, the Government building for postal service, a handsome public library, an Orphan's Home, and numerous hotels. There are many substantial school buildings, valued at $300,000, with a school enumeration of 6,500 children. Nearly all religious denominations are represented and well housed in the city.

History, Government, and Population.— The first settlement was in 1822, when, as the home of the Delaware Indians, it was known as Anderson's Town, the chief of the Delaware tribe being known as "Kik-tha-we-nund, or Ander-

son." Anderson's Town became a county-seat in 1827. The name was changed to Anderson by act of the Legislature in 1838, and in 1865 the city was incorporated. The city government is vested in a mayor and council, elected by the people. Pop. (1900) 20,178; (1905) 26,000.

JOHN L. FORKNER,
Mayor of Anderson.

Anderson, S. C., city and county-seat of Anderson County, on the Charleston & Western Carolina, and Blue Ridge railroads; 127 miles northwest of Columbia. The city was settled in 1827. It is in the centre of a large and fertile cotton-growing and agricultural region. It contains the city hall, court house and other large buildings, and numerous churches and schools. It has cotton-seed oil, eight cotton mills, lumber, and flour mills, and manufactures of fertilizers, clothing, machinery, and numerous small manufactories. The city is supplied by a private corporation with light and power from an electric plant located on the banks of the Seneca River, 10 miles distant. The same company supplies the water supply for the city. The municipal government is vested in a mayor and a council, elected every two years, under a charter of 1882. Pop. (1890) 3,018; (1900) 5,498; (1904) 8,500.

G. P. BROWNE,
Publisher 'Daily Mail.'

Andersonville, Ga., a village of Sumter County, 62 miles southwest of Macon, noted as the seat, during the Civil War, of a military prison of the Confederate States. This prison was established in November 1863, and consisted of an unsheltered enclosure containing at first 22 acres, an area subsequently increased to 27. It was commanded by Gen. W. S. Winder, but the superintendent was one Henry Wirz, a Swiss. It has been stated that Andersonville was selected as a suitable site because secure against Federal raiders and generally considered healthful; but that the laying waste of the fields of the South and the destruction of the means of transportation brought upon the Southern army and people great suffering, in which prisoners of war necessarily shared. It is true that rations were meagre for Confederate soldiers, to whose fare such prisoners were legally entitled. But evidence shows that the conditions which prevailed at Andersonville were due to mismanagement and cruelty; such evidence including ample Confederate testimony, as for example, that rendered by Dr. G. S. Hopkins and Surgeon H. E. Watkins, constituting a Confederate medical commission (1864), and that by Colonel Chandler of the Confederate war department in an inspection report (5 July 1864). Into the enclosure as many as 33,000 prisoners were at times crowded, for the most part completely without shelter, and supplied with insufficient and unsuitable food. Between February 1864 and April 1865 there were received at the prison 49,485 prisoners, of whom 26 per cent, or over 12,800, died there. In the autumn of 1864 the Confederate government removed many to Florence, S. C., and Millen, Ga., where they fared decidedly better. Wirz was convicted in 1865 by a military court under an indictment charging him with injuring the health and destroying the lives of prisoners, and was hanged 10 November. The prison burying-ground was made a national cemetery. Consult: Stevenson, R. R., 'The Southern Side; or Andersonville Prison' (1876); Chipman, 'The Horrors of Andersonville Rebel Prison' (1891); Schouler, 'History of the United States,' Vol. VI. (1899).

Andes, ăn'dēz, or, as called in Spanish South America, CORDILLERAS (ridges) DE LOS ANDES, or simply CORDILLERAS, a range of mountains extending along the whole of the west coast of South America, from Cape Horn to the Isthmus of Panama and the Caribbean Sea. Sometimes it is spoken of as a continuation of the Rocky Mountains in North America, but there seems to be no reason for this other than the continuity of the two divisions of America, and the fact that both ranges lie in the west of their respective continents. There is a sufficiently marked break between the ridges of the Isthmus of Panama and the range of the Andes of South America, and a still more distinct hiatus between the sierras of Central America and Mexico and the Rocky Mountains.

The south part of this huge chain begins to be continuous about lat. 52° S., and from this point to about lat. 42° S., a distance of nearly 1,100 miles, the range presses close to the Pacific Ocean. Its average height in this part is only about 3,000 feet, though several summits rise some thousands of feet higher, namely, Mount Melimoyu, Yanteles (the highest, above 8,000 feet), and the volcanoes of Corcobado and Minchinmadiva. The width of the chain in the extreme south is about 20 miles, further north it increases to 40 miles, and it attains a still greater width before reaching lat. 42° S. About this latitude the chain begins to recede from the coast, leaving wide plains on the west 1,000 or 1,500 feet above sea-level. North of lat. 35° S. a double range may be traced, and the whole system of mountains widens out to about 130 miles. At about lat. 21° S. the direction of the chain, which up to this point is north and slightly east, begins to change a little to the west, and around this elbow, as it were, is a knot of mountains, partly in Argentina and partly in Bolivia, consisting of chains running in various directions, some of which are unconnected with the chain of the Andes. This knot forms part of the watershed dividing the rivers of the La Plata from those of the Amazon basin. Among the peaks, up to 21° S. lat., are the active volcanoes of Antuco, Maypu, and Tupungato; but the culminating point of this portion, and so far as is known of the whole Andes, is Aconcagua, rising to the height of 23,028 feet, and distinctly visible from Valparaiso, 100 miles distant. The Chilean Andes, under the 35th parallel of south latitude, are about 150 miles from the Pacific; but this distance decreases to about 80 miles in the latitude of Valparaiso.

At lat. 21° S. the Andes range bifurcates, forming two chains of great elevation, the Andes of Bolivia and Peru, enclosing the lofty tableland or longitudinal valley of the Desaguadero and Lake Titicaca. Of these two chains the western or Peruvian has the peaks of Sahama, Parinacota, Gualateiri, and Pomarape, above 21,000 feet in height; and the eastern or Bolivian (Cordillera Real) those of Illimani and Sorata or Illampu (21,484 feet). The highest seems to be Gualateiri, the loftiest active volcano in the chain, 21,960 feet in height. Sahama, another active volcano, is 21,054 feet. These parallel cordilleras, the united breadth of

which nowhere exceeds 250 miles, are united at various points by enormous transverse groups or mountain knots, or else by single ranges crossing between them like dikes. The descent to the Pacific is exceedingly steep; the dip is also very rapid to the east, whence offsets diverge to the level plains. The table-land of the Desaguadero, thus enclosed, has itself an absolute altitude of 12,900 feet and an area of 150,000 square miles. A large eastern offset, the Sierra de Cochabamba, leaves the eastern cordillera under the 17th parallel, bounding the rich plain of Cochabamba north, and ending nearly under the 63d meridian of west longitude at Santa Cruz de la Sierra. The two main cordilleras once more unite in the group of Vilcañota, in lat. 15° S., and the united range then runs about 280 miles northwest to about lat. 10° S., where the Andes separate into three nearly parallel chains — the eastern, central, and western cordilleras, which enclose between them the Huallaga and Upper Marañon rivers; the western or coast cordillera running north as far as the group of Loja, near the southern extremity of Ecuador.

About lat. 6° S., opposite the Point Aguja, the Andes chain again takes a course north and slightly east, forming, as in Chile, a single mass or rocky plateau, 80 miles broad, covered with a double series of highly elevated summits enclosing longitudinal valleys, one of which, that of Cuenca, in the group of Assouan, is upward of 15,000 feet high, or nearly within the region of perpetual snow. North of this point the chain again divides, the western range comprising Mounts Chimborazo (21,240 feet), Iliniza, and Pichincha; while on the eastern range are the volcanoes Sangay, Tunguragua, Cotopaxi, Antisana (19,137 feet), and Mount Cayambe (19,535 feet). Shortly after entering New Granada, crossing the equator, the chain, in lat. 1° 5′ N., again meets in the knot or plateau of Los Pastos, on which is the volcano of Cumbal (16,620 feet); but a little north of the city of Pastos it once more bifurcates, enclosing the mountain plain of Almaguer, comprising the volcano of Purace (17,034 feet) on its eastern branch; and finally, somewhat north of the town of Popayan, the Andes separate into three distinct ridges — the Sierra di Choco, running north to the Isthmus of Panama; the Sierra di Quindiu, running east of the Cauca River; and the Sierra Suma Paz, extending east of the Magdalena to Lake Maracaibo and the city of Valencia in Venezuela. North of the fifth northern parallel the only summits within the snow line on these cordilleras belong to the eastern chain, which also is very precipitous on its eastern slope. On the Quindiu or central chain is the volcano of Tolima (18,325 feet), in lat. 4° 46′ N. The Choco or coast chain is of comparatively small elevation, its highest point not exceeding 9,000 feet. The total length of the Andes has been estimated at about 4,400 miles.

Passes, Roads, and Railways.— This gigantic mountain chain is traversed in its different parts by numerous roads or passes at heights almost equal to those of the extreme summits of the European ranges. Most of them are narrow, steep, and sometimes dangerous, passing through gorges, across yawning chasms, and up nearly perpendicular rocks; nor can they be attempted with success except by the active and well-practised native or the courageous and well-provided traveler. It is worthy of remark, likewise, that nearly all these roads cross the ridge transversely and direct, not, as is sometimes the case in the Alps, by a circuitous course through the longitudinal valleys. Subjoined is a list of most of the known mountain passes, with their position, connected localities, and highest elevation, commencing with those on the south.

Names		Feet
Portillo, lat. 33° 40′ S.	from Santiago to Estacada ... above	14,000
Peüquenes, lat. 33° 40′ S.	from Santiago to Estacada ... above	13,000
Cumbre, lat. 32° 52′ S.	from Valparaiso to Mendoza ... above	12,400
Pass of Tolapalca.	from Potosi to Oruro ... above	14,000
Pass of Condur Pacheta	from Potosi to Oruro ... above	14,000
Pass of Pacuani...	from La Paz to the Valley of the Beni...above	15,000
Pass of Gualillas, lat. 17° 50′ S...	from Arica to La Paz....	14,750
Pass of Chullunquiani	from Arica to La Paz ... above	15,000
Pass of Alto de Toledo, lat. 16° 2′ S.	from Arequipa to Puno ... above	15,500
Angostura	between Tacora & Lake Titicaca ... above	10,500
Pass by San Mateo, lat. 11° 48′ S.	from Lima to Tarma and Pasco ... above	15,700
Alto de Tacaibamba Pass	from Jauja to Huanuco ... above	15,000
Alto de Lachagual Pass	from Jauja to Huanuco ... above	15,000
Road over the Paramo de Assuay	from Alausi to Cuenca ... above	15,500
Road over the Quindiu Pass	from Alausi to Cartago...	11,502

Besides the routes just mentioned, a great commercial road runs longitudinally along the Andes the whole distance from Truxillo, lat. 8° 5′ S., to Popayan, lat. 2° 25′ N., in the valley of the Cauca, not much less than 1,000 miles, and attaining at its highest point, the Paramo de Bolicha, an elevation of 11,500 feet. Two railways across the Andes have already been completed, both in the republic of Peru. The first in operation extends from the port of Mollendo, near the south of Peru, by Arequipa to Puno on Lake Titicaca, a distance of 217 miles. The eastern terminus of this railway is situated in a table-land 12,196 feet above the level of the sea. The first locomotive reached the shores of Lake Titicaca on 1 Jan. 1874. The other and more recent railway is from Lima to Oroya, a distance of 145 miles. The crest of the Andes is traversed by a short tunnel at an altitude of 15,645 feet above sea-level; the steep and irregular slope up to this point being ascended by a series of sharp curves, and the ravines spanned by bridges. A transandean railway from Buenos Ayres to Valparaiso is nearly completed.

Rivers and Lakes.— From the Andes rise two of the largest water systems of the world — the Amazon and its affluents, and the La Plata and its tributaries. Besides which, in the north, from its slopes flow the Magdalena to the Caribbean Sea, and some tributaries to the Orinoco, but no streams of importance flow from its western slopes. The number of lakes interspersed through this vast mountain system is not great, and in this respect it presents a striking contrast to the Swiss Alps. The

MOUNT CHIMBORAZO IN THE ANDES.

21,420 FEET HIGH

A SOUTH AMERICAN INN.

NATIVE HOTEL IN THE CORDILLERAS

largest, and the only one worthy of notice, is that of Titicaca on the Bolivian plateau.

Geology, etc.— In considering the geology of the Andes, the first fact that strikes the observer is the vast development of volcanic force along the whole length of the chain, which is continued north through Guatemala and Mexico. These volcanic vents occur in three linear groups, the extreme southern extending from the 42d to the 33d parallel of south latitude; the next from the 27th to the 15th parallel, and the last from lat. 2° S. to about lat. 5° N. Mention has already been made of the principal volcanoes. Another striking circumstance in the geology of this range is that it consists almost entirely of sedimentary rocks, showing that its highest parts must at one time have been submerged. Granite comes so rarely to the surface in the northern parts of the chain, that, according to Humboldt, a person might travel for years in the Andes of Peru without meeting this species of rock; and he never saw any at a greater absolute elevation than 11,500 feet. Gneiss is sometimes found in connection with the granite; but mica-schist is by far the commonest of all the crystalline rocks. Quartz is likewise extremely abundant, generally mixed with mica, and rich in gold and specular iron. Vast tracts of red sandstone, with gypseous and saliferous marls, occur in Peru. Porphyry and greenstone abound all over the range at every elevation, both on the slopes and extreme ridges; and trachyte is almost as abundant as porphyry, both in Peru and Chile, great masses of it, from 14,000 to 18,000 feet thick, being visible on Chimborazo and Pichincha. As respects volcanic products, the western face of the Andes presents immense quantities of lava, tufa, and obsidian, none of which are found on the eastern side; this applies especially to that part of the chain lying between Chile and the equator. Fossil remains are by no means common; but in the limestone strata of the coast toward the northern extremity of the range Humboldt found many marine shells of the Silurian period, about 30 miles from the coast; and Pentland observed others of the same era at a height of 17,500 feet on Mount Antakawa in Bolivia, as well as in several other parts.

Earthquakes.— Many of the volcanoes, as before observed, are in a state of either constant or occasional action; it cannot, therefore, be matter of surprise that there should be frequent and violent earthquakes. All the districts of the Andes system, but Chile especially, have suffered more severely from these oscillations than any other part of the world; and among the towns either destroyed or greatly injured by these visitations may be mentioned Bogotá, Quito, Riobamba, Lima, Callao, Valparaiso, and Concepcion. In 1819 Copiapo was entirely overturned, not a house being left standing. Concepcion was twice destroyed — in 1730 and 1751; and in November 1822 an earthquake was felt on the same day at this town, in lat. 37° S., and at Lima in lat 12° N., more than 1,700 miles distant; it was on this occasion that Valparaiso, Melipella, and Quillota were all but completely annihilated. This earthquake, too, had the remarkable effect of upheaving the land on the coast, upward of 100 miles in extent, to the height of three or four feet, and elevating a portion of the shore above high-water mark. These shocks continued at brief intervals till the autumn of 1823; and since that time the volcanoes of Maypú, until then for many years quiescent, have had frequent eruptions. In August 1868 the towns of Arequipa, Iquique, Tacna, and many other smaller towns in Peru and Ecuador, were destroyed. Earthquakes, slight or more serious, are of yearly occurrence, and faint oscillations of the soil are regarded with scarcely more attention than a hail-storm in the temperate zone.

Mineral Productions.— The Andes are extremely rich in the precious metals. In Chile, Bolivia, Peru, and Colombia gold is obtained. Silver occurs in Chile in the provinces of Coquimbo and Atacama, and the mines of these districts are remarkable for the richness of their ores. The Peruvian Andes have numerous silver mines scattered over their whole extent from the province of Caxamarca south to the confines of Chile; but incomparably the richest are the mines of Cerro de Pasco, which have been worked upward of two centuries. The mines of Chota likewise, which are situated on Mount Hualgayoc, are productive. The ore, which is richer even than that of Pasco, lies either on or very near the surface. Close to the Pacific, at Huantajaya, in the district of Arica, are several mines celebrated for the quantity of virgin silver found therein, sometimes in masses of great weight. The most famous mines are those of the Cerro de Potosi, in Bolivia, lat. 19° 36′ S., which is perforated in all directions by thousands of openings, some of which are within 100 feet of the summit (16,000 feet). Quicksilver is found in several parts of the Andes, but in combination with sulphur, forming the red sulphuret of mercury commonly known as cinnabar. Copper is found both in the east and west cordilleras of Peru; but the eastern chain is too far from the coast to admit of mines being profitably worked. The copper mines of Chile are the most valuable. They are situated chiefly in the desert of Atacama. Tin also, wrought in Chile, forms an article of export; but lead and iron, though plentiful, are not worked. Considerable platinum is obtained from the state of Choco in Colombia.

Climate and Meteorology.— On the western side of the range little or no rain falls, except at the southern extremity; and scanty vegetation appears only in spots, or in small valleys, watered by streams from the mountains; while on the opposite slope excessive heat and moisture combine to give the range a thick covering of tangled forest trees and dense brushwood. Currents of cold west and northwest winds blow nearly all the year from the ice-topped cordilleras on the plateau beneath, daily accompanied during four months by thunder, lightning, and snow storms. Currents of warm air are also occasionally found on the crest of the Andes; they usually occur two hours after sunset, being both local and narrow, like the hot blasts in the Alps, not exceeding a few yards in width. They run parallel to each other, and so closely that five or six of them may be passed in a few hours. They blow chiefly from south-southwest to north-northeast and are especially frequent in August and September. Notwithstanding the great number of snow-clad summits, glaciers are of rare occurrence in the

Andes, being found only, and then of but small extent, in the narrow ravines which furrow the sides of some of its giant summits.

Vegetation.— In the low torrid plains that flank the bases of the Andes reign the banana, cycas, plaintain, cassava, cacao, the cotton tree, indigo and coffee plant, and sugar-cane, all of which are extensively and profitably grown below the altitude of 4,000 feet. Maize is likewise plentiful, and may be said to form the bread of the Peruvians; it is of three different kinds, and, according to Humboldt, is cultivated 7,000 feet above the sea. Within the same limits also are found, either wild or cultivated, the pineapple, pomegranate, shaddock, orange, lime, lemon, peach, apricot, together with olives, aji or pepper plants, tomatoes, sweet potatoes, gum copal, copaiba balsam, dragon's blood, sarsaparilla, and vanilla. To these groups succeed, in the humid and shaded clefts on the slopes of the cordilleras, the tree-ferns, and cinchona or cascarilla, whence we derive the febrifuge bark and quinine. Between the heights of 6,000 and 9,000 feet is the climate best suited for the European cereals. To these may be added the quinoa (*Chenopodium quinoa*), a most useful production for domestic uses. In this region also, and a little above it, grow the potato, indigenous to Chile and thence introduced into Europe, and various tuberose congeners, all extensively used as food; and here likewise grow the chickpea, broad bean, cabbage, and other European vegetables. Within the cereal limits are found the oak, elm, ash, and beech, which never descend lower than 5,500 feet, and seldom rise higher than 9,200 feet above the sea. Above this level the larger forest trees, except the pine, begin to disappear.

Zoology.— The fauna of the Andes is still very imperfectly known. Among the carnivorous animals the principal are the jaguar, puma, ounce, ocelot, and wild-cat. There are also bears, tapirs, raccoons, wild hogs, foxes, and otters, with both red and roe deer. The characteristic animals of the Andes, however, are the llama and its different congeners — the guanaco, vicuña, and paco or alpaca. They are the chief beasts of burden on the Andes. The forests of the warmer regions abound with members of the monkey tribe, etc. Many varieties of serpents are found. Bats are numerous and of large size, the vampire bat being one of the most remarkable. The condor soars over the highest summits, making its nest among the highest and least accessible rocks; other birds of prey are also numerous. Curassows, wild turkeys, parrots, and parrakeets are common in the woods, and there are also a great many varieties of smaller birds.

MARRION WILCOX,
Authority on Latin-America.

An'des and the Amazon, The, a volume of travels by James Orton (1870, enlarged ed. 1876). Under the auspices of the Smithsonian Institution, the author, who for many years was professor of natural history at Vassar College, led an exploring expedition to the equatorial Andes and the river Amazon. Its experiences are set forth in this work.

Andesine, ăn'dēz-ĭn, a triclinic feldspar, intermediate in composition between albite and anorthite. Albite and anorthite are isomorphous, and andesine includes those mixtures of the two in which the ratio of albite to andesine ranges from 1:1 to 3:2. Andesine may be described as an anhydrous silicate of sodium, aluminum, and calcium. Its hardness is from 5 to 6, and its specific gravity about 2.68. In color it is white, gray, greenish, yellowish, or pink. It was first found in the Andes (whence the name), but has since been observed in Alsace, in Iceland, and in other localities. In the United States it occurs at Sanford, Me.

Andesite, ăn'dēz-īt, a common volcanic rock, consisting of a triclinic feldspar (such as andesine) mixed with hornblende or augite and sometimes also with quartz. It varies in color from green to gray and occasionally has a purplish cast. It is difficult to define andesite accurately because basalt, andesite, and trachyte are similar in composition, and intermediate varieties exist, which, with the typical rocks of the three classes, form an almost continuous series. Andesite is more fusible than trachyte, but less fusible than basalt.

Andigan, än'dĭ-jän', a city of the Russian khanate of Khokandin, central Asia. It is the centre of an immense cotton-raising district, whence Russia received three fourths of all the cotton used in the empire. In 1902 the city was totally destroyed by an earthquake which killed over 5,000 of the 47,000 inhabitants.

Andira, ăn-dī'rȧ, a genus of leguminous typical American trees, with fleshy plum-like fruits. The wood is well fitted for building. The bark of *A. inermis,* or cabbage-tree, is narcotic, and is used as an anthelminthic under the name of worm bark or cabbage bark. The powdered bark of *A. araroba* is employed as a remedy in certain skin diseases, as herpes.

Andocides, ăn'dŏs'ĭ-dēz, an Athenian orator: b. 467 B.C.; d. about 393 B.C. Active in public affairs, he was four times exiled; the first time along with Alcibiades, for profaning the Eleusinian mysteries. Three of his orations are extant.

Andorra, ȧn-dŏr'rȧ, a small republic in the Pyrenees between Ariège, a department of France, and Lérida, a province of Spain. It is only partially independent, being under the suzerainty of both France and Spain. The town covers an area of 175 square miles and the inhabitants are devoted chiefly to cattle-raising and iron and lead mining. The republic and its history have attracted much attention from students of governmental institutions. Pop. 6,000. See Tucker, 'The Valley of Andorra' (1882); Deverell, 'History of the Republic of Andorra' (1885); Spender, 'Through the High Alps' (1898).

An'dover, an English market town in Hampshire, 12 miles west of Winchester. Its large parish church was built about 1850 on the site of a Norman predecessor. The Massachusetts Andover was named in honor of the Hampshire town. Pop. about 6,000.

An'dover, Mass., a town in Essex County, on the Merrimac River and the Boston & M. R.R.; 23 miles north of Boston. It is widely known as the seat of the Andover Theological Seminary (q.v.), the Phillips Academy for boys, and the Abbot Academy for girls, and has manufactories of flax, shoes, and woolen goods, two national banks, Memorial Hall, and school libra-

ries, a free public library of over 12,000 volumes, and a property valuation of over $4,000,000. Harriet Beecher Stowe lived here many years, and it was long the home of Elizabeth Stuart Phelps Ward. It was first settled in 1646. Pop. (1900) 6,813.

An'dover Theolog'ical Seminary, Andover, Mass., one of the oldest and most famous theological schools in the United States. It was founded in 1807, at a period when there was little provision for special education in theology, the Greek or Hebrew languages, Biblical criticism, etc.; and it was usual for ministerial candidates to study for a time under the private tuition of some noted divine. These private divinity schools were often very effective intellectually and practically, but could not supply the minute and accurate scholarship of regular institutions with longer set terms, the need of which was now sharply felt. At this time also, not only was New England divided into strenuous Calvinists and semi-Calvinists or outright Arminians, but the former were themselves divided into Calvinists proper and Hopkinsians, a more extreme type. Under a common alarm at the inroads of religious liberalism, however, the former drew together and united in upholding a general theological seminary. This was founded by Samuel Abbot, a Boston merchant, who associated with him Phœbe Phillips, widow of the founder of Phillips Academy, and her son John; and the three drew up a constitution for the seminary, submitted it to the General Assembly June 1807, and committed it to the board of trustees 31 Aug. 1807. The articles were rigidly drawn to prevent the teaching of anything but the especial form of Calvinism held by the founders, the endowment to be forfeited if these restrictions were disregarded. But no such provision could be enforced in an age of free thought and consequent flux of belief without shutting up the seminary. The trustees have had twice to choose between relaxing the iron-bound rules of the deed and closing the doors. By the irony of fate the defenders against assaults for heresy in the one generation were the chief prosecutors of it in the next. The seminary makes no charge for tuition or room rent, the endowment fund ($850,000 in 1901) providing for all; and though under Congregational control it is free to all Protestants who can present a college diploma. The latter requirement can be waived by the trustees. The library contains over 30,000 volumes. In 1900 there were six professors besides five lecturers and tutors. President, Geo. Foot Moore, D.D. (For its foundation and history from a rigidly orthodox standpoint see Leonard Woods' 'History of Andover,' Boston, 1884.)

An'drādīte (named for the Portuguese mineralogist, d'Andrada), the common or black garnet. See GARNET.

Andral, än'drȧl', **Gabriel,** a distinguished French physician and pathologist: b. in Paris, 6 Nov. 1797; d. 13 Feb. 1876. In 1827 he was called to the chair of hygiene, in 1830 to that of pathology in the University of Paris. Andral may be said to have been the first to apply an analytical and inductive method to pathology. His 'Medical Clinic' (1824) established his reputation, and his 'Summary of Pathological Anatomy' (1829) was equally successful. Other works of importance are his 'Essay on Pathological Hæmatology' (1843); 'Course in Pathology — Interne'; and 'Investigations into the Modification of the Relative Proportions of Hæmatic (Blood) Principles.'

Andrassy, än'drä-shĭ, **Julius, Count,** Hungarian statesman: b. Zempben, 8 March 1823; d. 18 Feb. 1900. He took part in the revolution of 1848 and was condemned to death, but escaped and went into exile. Appointed premier when self-government was restored to Hungary in 1867, he became imperial minister for foreign affairs in 1871; drew up the famous Andrassy note to the Porte in 1876; was a conspicuous member of the Congress of Berlin in 1878; negotiated the German-Austrian alliance with Bismarck in 1879; retiring the same year from public life. The Andrassy "Note" was a declaration relating to the disturbed condition of Bosnia and Herzegovina, formulated by the governments of Austria, Russia, and Germany, with the approval of England and France. It commanded the establishment of religious liberty, the application of local revenues to local purposes, and other reforms, and was formally presented to the Porte, 31 Jan. 1876.

André, än'dra, or ăn'drĭ, **John,** a British soldier: b. London, of Swiss-French parentage, 1751; executed at Tappan, N. Y., 2 Oct. 1780. His fate is peculiar; failure has given him a monument in Westminster Abbey from his own side, and undying romantic pity from the other, where success would have loaded him with infamy from one, and made the other glad to forget him. He entered the English army at 20, and was sent to Canada in 1774; November 1775 he was taken prisoner at St. John's by Montgomery's expedition and sent to Lancaster, Pa. Exchanged in December 1776, he was made captain in 1777, aide to Gen. Charles Grey, major in 1778, and in 1779 aide to Clinton and adjutant-general of the forces in America. He owed this rapid advancement, as he has owed his enshrinement by posterity, to his extraordinary and somewhat feminine charm of person and manner, which won the hearts not only of his chiefs and associates, but of the very officers who put him to death. He was full of wit and vivacity, a most entertaining companion, a good amateur musician and artist, and a fluent, pleasing writer, which, more than all else, made him Clinton's adjutant and secretary. He was also a fair society poet, known in London literary circles; and his casual skits in verse, 'The Cow Chase,' 'Yankee Doodle's Expedition to Rhode Island,' 'The Affair Between Generals Howe and Gadsden,' etc., were great favorites in the English army. During that army's winter in Philadelphia, 1777–8, André was the promoter of and a chief actor in all the festal occasions and social events, including the 'Mischianza,' a pageant in honor of Howe on his departure. In 1780 it fell to his official duty to conduct Clinton's negotiations with Benedict Arnold (q.v.) for the betrayal of West Point, the key of the Hudson, whose command Arnold had solicited in order to betray it, with its magazines and the entire stock of powder of the American army. Both sides were wary and suspicious of each other, and Clinton uncertain of his correspondent's identity or whether the affair might not be

a trap. After various abortive attempts at a secret interview, André, on 19 September, went as "John Anderson" up the Hudson in the sloop-of-war Vulture, nearly to the American lines above Fort Montgomery. The plan was to meet under a flag of truce, on pretense of arranging as to the confiscated property of the loyalist Col. Beverly Robinson, whose house was Arnold's headquarters; but this, too, failed, and finally on the night of 21 September Arnold induced a loyalist farmer, Joshua Smith, to carry a packet from Robinson to "Anderson" on the Vulture. André returned with Smith, was met on the shore by Arnold, and after a private conference the two went to Smith's house, where they spent the night and part of the next day arranging the betrayal, which was fixed for the day of Washington's expected return. Arnold gave him six papers containing drawings of the West Point defenses and full information concerning them, and passes to return to New York either by land or water. He also sent Smith as escort, charged not to leave André till he had reached the English lines in safety. But in the morning the American batteries had fired on the Vulture and driven her so far down stream that the boatmen would not carry him to her. André, therefore, disguising himself as a civilian, set out on horseback, carrying the papers in his boots. Smith, despite Arnold's injunction, left André on the way, probably in fear for himself. About 9 A.M. of the 23d, near Tarrytown, and almost in sight of the British lines, he was stopped by three patriot militiamen, John Paulding, David Williams, and Isaac Van Wart. Supposing them to be Tory "cowboys," he told them he was an English officer, and offered them money. Finding that they were not loyalists, he offered more and his horse, showing also Arnold's pass. Their suspicions thoroughly aroused, they searched him, found the papers, and carried him to one Lieut-Col. Jamison, who, not suspecting treachery on Arnold's part, notified him of the capture and proposed to hand the prisoner over to him. The gleam of hope was delusive, and André was finally sent to Washington, while Arnold fled to the Vulture and saved his own life. By military law André was, of course, subject to immediate hanging; but in consideration of his rank, Washington on 29 September convened a military court of six major-generals and eight brigadier-generals, with Gen. Nathanael Greene as president, who unanimously convicted him of being a spy and sentenced him to death on 2 October. Clinton, of course, did his best to save André, protesting that he was not a spy because he was under a flag of truce (which was false), and that his movements were in obedience to the directions of Arnold, an American commander,— a grimly humorous defense under the circumstances; but Washington replied with firm courtesy that the circumstances justified no exception to the rules of war. André died like a man, and need not be grudged our pity; but he was treated with a generous humanity curiously in contrast with the treatment accorded to Nathan Hale.

A monument to André was placed in Westminster and in 1821 his remains were taken up and reburied near it. See Sparks, 'Life of André' in 'American Biographies'; Sargent, 'Life of André' (1861); Lossing, 'Two Spies,' 1886. Lord Mahon in his 'History of England' assumes Clinton's case for André as good both in law and in equity. In 1858 Charles J. Biddle, a Philadelphia editor and ex-soldier, reviewed Mahon's opinions before the Pennsylvania Historical Society. See its 'Memoirs,' Vol. VI. For documents see H. W. Smith's 'Andréana' (1865); Dawson's 'Collection' (1866).

André, än'dra, **Louis Joseph Nicolas,** a French military officer: b. in Nuits, Burgundy, 29 March 1838. He was graduated at the Polytechnic School, and in 1865 became captain, serving in that capacity throughout the Franco-Prussian war of 1870–1. He was made general of brigade in 1893 and placed in charge of the Polytechnic School. On 29 May 1900 he was appointed minister of war by President Loubet, succeeding General the Marquis de Gallifet, who held the office during the exciting period of the Dreyfus revision.

André, än'dra, **St., Jacques d'Albon,** Marquis of Fronsac, generally known as Maréchal de St. André, a French nobleman, made gentleman of the bedchamber by Henry II. In 1550 he was deputed to bear the collar of his order to Henry VIII. of England, by whom he was invested with that of the Garter. On his return he was appointed to the command of the army in Champagne, where he greatly distinguished himself till taken prisoner at the battle of St. Quentin. On the death of Henry II. he was chosen one of the regency. Killed at the battle of Dreux in 1562. The Huguenots called St. André «The Harquebusier of the West."

Andreä, än'dra, **Jakob**, a German Protestant theologian: b. in Waiblingen 25 March 1528; d. in Tübingen 7 Jan. 1590; became professor of theology and chancellor of the University of Tübingen in 1562, and was the author of over 150 works, nearly all of a polemical character, besides being the chief author of the 'Formula Concordiæ.'

Andreä, an'dra, **Johann Valentin,** a German theologian: b. Herrenberg in 1586, near Tübingen; d. Stuttgart, 1654. He studied at Tübingen, became a Protestant pastor, and was chaplain to the court at Stuttgart. Eminently practical in mind, he was grieved to see the principles of Christianity made the subject of mere empty disputations, and accordingly devoted his life to the correction of this tendency of his age. His writings are remarkable for the wit and humor as well as for the acuteness and moral power which they display. He was long regarded as the founder or restorer of the order of the Rosicrucians, a view based on his quaint but misunderstood 'Chemical Jubilee of Christian Rozenkreuz' (1616). But his intention was certainly not to originate or promote a secret society of mystics, but to ridicule the follies of the age, including the theosophic Rosicrucians. He wrote mainly in Latin, but also in the Suabian dialect. Among the best of his works are his 'Menippus, or a Hundred Satyric Dialogues' (1617), and his 'Spiritual (Clerical) Relaxation' (1619).

An'drea del Sarto. See SARTO.

Andreasberg, än-drā'äs-bĕrg, **Saint,** a Prussian mining town in the province of Hanover, 57 miles southeast of the town of Hanover, on a site, 1,800 feet above sea-level, a little to the

southwest of the Brocken. The minerals obtained in the mines of the district are silver, copper, lead, arsenic, etc. The Samson shaft, 2,950 feet deep, is the deepest mine in the Harz Mountains. Pop. 4,000.

Andree, än'dra, **Salomon Auguste,** a Swedish aëronaut: b. in Grenna, 18 Oct. 1854; date of death unknown. He was educated in Stockholm. In 1882 he took part in a Swedish meteorological expedition to Spitzbergen. In 1884 he was appointed chief engineer to the patent office, and from 1886 to 1889 he occupied a professor's chair at Stockholm. In 1892 he received from the Swedish Academy of Sciences a subvention for the purpose of undertaking scientific aërial navigation. From that time he devoted himself to aërial navigation, making his first ascent at Stockholm in the summer of 1893. In 1895 he presented to the Academy of Sciences a well-matured project for exploring the regions of the North Pole with the aid of a balloon at an estimated cost of about $40,000. A national subscription was opened, which was completed in a few days, the king of Sweden contributing the sum of $8,280. With two companions, Dr. S. T. Strindberg and Herr Fraenckell, Andree started from Dane's Island, Spitzbergen, 11 July 1897. His balloon was 67¼ feet in diameter, with a capacity of 170,000 cubic feet. Its speed was estimated at from 12 to 15 miles an hour, at which rate the Pole should have been reached in six days provided a favorable and constant wind had been blowing. Two days after his departure a message was received from Dr. Andree by carrier pigeon, which stated that at noon, 13 July, they were in lat. 82.2° and lon. 15.5° E., and making good progress to the east, 10° southerly. Several expeditions sent in search of Andree have returned without obtaining any further intelligence of the explorer.

Andreini, än'dra-ē'nẹ, **Giovanni Battista,** an Italian comedian and poet: b. in Florence, 1578; d. in Paris about 1650. From his sacred drama, 'Adam' (1613), Milton is by some supposed to have derived the idea of 'Paradise Lost.'

An'dreolite, än'drē-ō'līt (from Andreasberg, in the Harz Mountains), a mineral better known as harmotome (q.v.). The name andreolite should be retained for it according to the law of priority; but mineralogists have preferred to adopt the name harmotome, as given by Haüy, although no good reason can be assigned for so doing.

Andreossy, än'dra'ọ'se', **Antoine François, Count,** a French general and statesman: b. Castelnaudary in Languedoc, 6 March 1761; d. at Montauban, 10 Sept. 1828. He entered the artillery in 1781, joined the revolutionists, served under Bonaparte in Italy and Egypt, and took part in the revolution of the 18th Brumaire. He was ambassador at London, at Vienna, and at Constantinople, from which latter post he was recalled at the restoration. He was raised to the peerage by Napoleon after his return from Elba. After Waterloo he advocated the recall of the Bourbons, but, as deputy, generally took part with the Opposition. He was elected to the Academy in 1826. He was a man of eminent scientific attainments, one of his earliest works being the 'Histoire Générale du Canal du Midi (1800). Besides his scientific works he wrote several military "Memoirs."

An'drew, a Neapolitan king, assassinated with the connivance of his queen in 1345.

An'drew, James Osgood, an American Methodist bishop: b. in Wilkes County, Ga., 3 May 1794; d. in Mobile, 1 March 1871. He was an itinerant preacher in South Carolina from 1816 till consecrated bishop, 1832. His social relations were the immediate cause of the division of the Methodist Episcopal Church into "North" and "South." His second wife whom he married in 1844 was a slave holder; and the General Conference of that year resolved that he should "desist from the exercise of his office" on the ground that the fact of his wife's owning slaves "would greatly embarrass if not in some places entirely prevent" the exercise of this office. The Southern delegates protesting against this action, the difficulty was settled only by dividing the churches and property into the Northern and Southern jurisdiction. Bishop Andrew adhered to the South, retiring from active work in 1868.

An'drew, John Albion, an American statesman, the "War Governor" of Massachusetts: b. Windham, Me., 31 May 1818; d. Boston, 30 Oct. 1867. He was graduated from Bowdoin College in 1837, and practised law in Boston 1840–61. He was an earnest anti-slavery advocate and defended the fugitive slaves Shadrach, Burns, and Sims. Elected to the State legislature in 1858, was a delegate to the Chicago Convention in 1860, and being nominated governor was elected by an immense majority. He forecast the war, announced in his message the intention to put the State militia on a war footing, and privately invited co-operation from other governors. On Lincoln's first call for troops, 15 April 1861, he sent them so promptly that on 19 April the 6th Massachusetts shed the first blood of the war in passing through Baltimore, and within a week he had dispatched to the front five regiments of infantry, a battalion of riflemen, and a battery of artillery. In 1862 he urged the national abolition of slavery and the enrollment of colored troops, and in 1863 sent out the first colored regiment, 154th Massachusetts; yet he repeatedly interfered to prevent harrying Southern sympathizers by arbitrary arrests, and after the war was foremost in urging conciliation and abstinence from vindictive or humiliating measures. He was re-elected regularly till 1866, when he refused further honors from pecuniary grounds and impaired health, continuing his law practice till death. He was a man of great personal charm and oratorical force, intensely sympathetic and humane, and of simple and frank nature. In religion he was a moderate Unitarian, believing in Christ's supernatural character, and was president of the first Unitarian National Convention in 1865.

An'drew, Saint, one of the twelve Apostles, and the brother of Peter. There are four important references to him in the gospels. John i. 40, the only account of his introduction to Jesus, in which as a disciple of John the Baptist he follows Jesus on John's word and brings his brother Peter to him; John vi. 8, where he calls attention to the boy with the barley loaves, when the miracle of the loaves

and fishes occurs; John xii. 22, where Philip, asked by the Greeks if they may see Jesus, consults Andrew before laying the request before Jesus; and Mark xiii. 3, where he is one of the four who privately asked Jesus the meaning of his utterance about the ruin of the temple. The other two synoptics do not allude to him. John i. 44 says he was from Bethsaida in Galilee. Tradition early gave him a conspicuous place among the Twelve, and very important "acts of the Apostle Andrew" were in circulation as early as the middle of the second century, but have survived only in later recasting. There were also acts of Matthew and Andrew, and of Peter and Andrew, and a "Martyrdom of Andrew." A gospel of Andrew is mentioned later, but not otherwise known. A tradition of unknown date and no value accredits him with preaching in north Greece and Epirus and in Scythia, and being martyred on a cross shaped like an X at about 70 A.D.

Andrew I., a king of Hungary, 1046–1061; compelled his subjects to embrace Christianity, exiled his brother Béla, and died in battle.

Andrew II., king of Hungary, 1205–1235, who fought in the crusades, and displayed great valor; granted the Golden Voull, styled the Hungarian Magna Charta.

Andrew III., king of Hungary, 1290–1301. He was opposed in his claims to the throne, and involved in a civil war during his reign; he died in 1301.

An'drew, Saint, Cross of, is a white saltire on a blue ground, to represent the X-shaped cross on which the patron saint of Scotland suffered martyrdom, from an early date adopted as the national banner of Scotland. It is combined with the crosses of St. George and St. Patrick in the Union Jack. The Scottish Order of the Thistle is sometimes known as the Order of St. Andrew.

An'drew, Saint, The Russian Order of, the most important of Russian orders, founded by Peter the Great in 1698. It has but one class and is confined to members of the imperial family, princes, and persons of the rank of general who already hold two other important orders. The badge of the order displays on the obverse the double-headed eagle, crowned, on which is a St. Andrew's cross enameled in blue, with a figure of the saint and bearing in the four corners the letters S. A. P. R. (*Sanctus Andreas Patronus Russiæ*).

An'drewes, Lancelot, an eminent bishop of the English Church: b. near Barking, Essex, 1555; d. London, 25 Sept. 1626. Having taken orders he was appointed to the parsonage of Alton, afterward to the vicarage of St. Giles, Cripplegate, and in 1589 was made a prebend and canon of St. Paul's, and master of Pembroke Hall. Queen Elizabeth, esteeming him highly, appointed him one of her chaplains in ordinary, besides bestowing other preferment upon him; and he was in no less favor with James I. In 1605 he became bishop of Chichester, in 1609 was translated to Ely and appointed one of the king's privy councilors, and in 1618 was translated to Winchester. He was one of the greatest preachers of his time, and was one of those engaged in preparing the authorized version of the Scriptures. He left sermons, lectures, and other writings, a manual of private devotions compiled by him in Greek and Latin being well known through several English translations.

An'drews, Charles Bartlett, an American jurist: b. Sunderland, Mass., 4 Nov. 1834; d. Litchfield, Conn., 12 Sept. 1902. He was graduated from Amherst College; member Connecticut Senate 1868–9; of the House 1878; governor of Connecticut 1879–81; judge of the supreme court 1882–9, and chief justice 1889–1901. He presided over the Connecticut constitutional convention of 1902.

An'drews, Charles McLean, an American historical and descriptive writer: b. in Wethersfield, Conn., 22 Feb. 1863; became professor of history at Bryn Mawr College; author of 'Historical Development of Modern Europe;' 'River Towns of Connecticut;' 'The Old English Manor,' etc.

An'drews, Christopher Columbus, an American diplomat and writer: b. in Hillsboro, N. H., 27 Oct. 1829; was brevetted major-general in the Civil War; United States minister to Sweden from 1869 to 1877, and consul-general to Brazil from 1882–1885. Among his many works are 'Minnesota and Dakota' (1857); 'Practical Treatise on the Revenue Laws of the United States' (1858); 'History of the Campaign of Mobile' (1867), and 'Brazil, Its Condition and Prospects' (1887).

An'drews, Edward Gayer, an American clergyman: b. New Hartford, N. Y., 7 Aug. 1825. Graduated from Wesleyan University, Conn. 1847; entered the Methodist ministry 1848; principal of Casenovia Seminary, 1854–64; pastor in Stamford, Conn., and Brooklyn, N. Y., 1864–72; and elected bishop 24 May 1872. He visited missions in Europe and India 1876–7; Mexico 1881; Japan and China 1889–90; and was delegate to English and Irish Methodist Churches 1894.

An'drews, Elisha Benjamin, an American college president: b. Hinsdale, N. H., 10 Jan. 1844. Served in Connecticut regiments through the Civil War, rising to the rank of 2nd lieutenant; graduated at Brown University 1870, and Newton Theological Institution 1874. Teacher and pastor, 1874–82, professor of history and political economy at Brown 1882–8; of political economy and finance at Cornell 1888–9. In the year last named he was elected president of Brown University and under his administration that institution greatly increased its efficiency. In 1897 he resigned the presidency on account of criticism of his views on the silver question, but complied with the request of his trustees to withdraw his resignation. He was elected superintendent of schools in Chicago 1898, and in July 1900, chancellor of the University of Nebraska. He has written: 'Institutes of General History' (1887); 'Institutes of Economics' (1892); 'An Honest Dollar' (1894); 'Wealth and Moral Law' (1894); 'History of the Last Quarter Century in the United States' (1896). Colby University conferred on him the degree of D.D., and the University of Nebraska that of LL.D.

An'drews, Ethan Allen, an American scholar: b. New Britain, Conn., 7 April 1787; d. there 4 March 1858. Graduated at Yale in

1810, studied law and practised for some years. Then taught ancient languages in University of North Carolina, the New Haven gymnasium, 1822–9; established New Haven Young Ladies' Institute, 1830; succeeded Jacob Abbott as head of a young ladies' school in Boston 1833–9. Returning to New Britain he devoted himself to the publication of a series of Latin text-books, which soon became widely used throughout the United States. The most important of these were 'Andrews' and Stoddard's Latin Grammar'; and 'Latin-English Lexicon' (1850), an abridged translation, with alterations and additions, of Freund's 'Wörterbuch der Lateinischen Sprache.'

Andrews, George Pierce, American jurist: b. North Bridgeton, Maine, 29 Sept. 1835; d. New York 24 May 1902. He was educated at Yale, studied law and was admitted to the bar in 1861. He was United States district attorney for six years, assistant and corporation counsel, New York, 1872–84, and associate justice of the New York supreme court, 1884–1901. He was esteemed a high authority on municipal and corporation law and his opinions in tax cases were especially valued. A very notable event in his career was his conviction of Capt. Nathaniel Gordon in 1860 for slave trading. Gordon was captured with a crew of nearly 900 negroes, was twice tried for piracy and finally convicted as a result of the convincing argument of Andrews. It is generally conceded that the conviction and execution of Gordon ended the slave trade in the United States. It had existed for more than 300 years, and for 42 years after Congress had made it piracy, punishable with death. Thousands of negroes had suffered tortures on the long voyages between African and American ports, and thousands more had died and been cast overboard, but not a person engaged in the nefarious traffic had been punished in this country until Mr. Andrews obtained the conviction and execution of Gordon. Prior to that event 130 vessels had been engaged in the slave trade, and New York was their headquarters. See UNITED STATES — SLAVERY IN THE.

An'drews, Jane, an American juvenile story-writer: b. in Massachusetts in 1833; d. 1887. Among her stories for children which have enjoyed great popularity are 'Seven Little Sisters Who Live on the Round Ball That Floats in the Air' (1876); 'The Stories Mother Nature Told'; 'The Seven Little Sisters Prove their Sisterhood' (1878); 'Ten Boys on the Road from Long Ago to Now' (1885); 'Only a Year and What It Brought' (1887).

An'drews, John N., an American military officer: b. in Delaware, 1838. He was graduated at West Point in 1860; served with distinction through the Civil War; commissioned colonel of the 12th United States infantry in 1895; and appointed a brigadier-general of volunteers for the war against Spain in 1898.

An'drews, Lorrin, an American missionary: b. East Windsor, Conn., 29 April 1795; d. Honolulu, 29 Sept. 1868. He was educated at Jefferson College and Princeton Theological Seminary; missionary in the Hawaiian Islands, 1827, until, in 1840, from anti-slavery scruples, he resigned connection with the American Board. He became a judge and secretary of the privy council, 1845–55; translated a part of the Bible into Hawaiian and compiled the following works: 'Vocabulary of Words in Hawaiian' (1836); 'Grammar of the Hawaiian Language' (1854); 'Dictionary of the Hawaiian Language' (1865); all published in the island.

An'drews, Samuel James, an American clergyman: b. Danbury, Conn., 31 July 1817. Graduated at Williams College, 1839, he was admitted to the bar in Connecticut and Ohio and practised law in those States 1842–4. He then studied at Lane Theological Seminary; ordained in Congregational ministry, 1846; pastor, East Windsor, Conn., 1848–55; adopted the Irvingite doctrines and has been in charge of a Catholic and Apostolic Church congregation in Hartford, Conn., from 1868 to the present. Author of 'Life of Our Lord Upon Earth' (1862); 'God's Revelations of Himself to Men' (1885); 'Christianity and Anti-Christianity in Their Final Conflict' (1898); 'The Church and Its Organic Ministries' (1899); 'William Watson Andrews: A Religious Biography' (1900).

An'drews, Stephen Pearl, an American author: b. Templeton, Mass., 22 March 1812; d. New York city, 21 May 1886. Educated at Amherst; practised law in New Orleans and Texas. His enthusiastic advocacy of the abolition of slavery took him to England in 1843 to raise money to pay for the slaves and make Texas free. He learned in England phonography, and became the founder in this country of the present system of phonographic reporting, editing journals devoted to it, and publishing numerous instruction books. Early in life he announced the discovery of the unity of law in the universe, and devoted the last half of his life to developing this philosophy, called by him "Integralism," and to the construction of a universal language which he named "Alwato," as a part of this system of "universology." He spoke several languages and is said to have had a knowledge of thirty. In 1882 he instituted the "Colloquium," a series of conferences for the exchange of opinions between leading New York clergymen and others of the widest diversity of religious, philosophical, and political views. His chief works are 'Discoveries in Chinese' (1854); 'Synopsis of Universology and Alwato' (1871); 'Basic Outline of Universology' (1872); 'Grammar of Alwato' (1877); 'Transactions of the Colloquium,' (Vols. I., II., 1882–3); 'The Church and Religion of the Future' (1886).

An'drews, William, an English author and compiler: b. Kirkby Woodhouse, Nottinghamshire, 11 Aug. 1848. He established the Hull Press in 1890, and is the librarian of the Royal Institution at Hull. Among his many publications are 'Old Church Lore' (1891); 'Bygone England' (1892); 'Modern Yorkshire Poets'; 'Historic Byways and Highways'; 'Bygone Punishments.'

An'drews, William Draper, an American inventor: b. Grafton, Mass., 1818; d. 1896. In 1844 he invented the centrifugal pump which made it possible to save goods not injured by water from abandoned wrecks; the pump was manufactured in England as the Gwynne pump; was patented in the United States in 1846. Later he invented and patented the anti-friction centrifugal pump; made various modifications of centrifugal pumps, and patented a widely-used system of gangs of tube-wells.

Androconia, ăn'dro-cō'nĭ-ȧ, certain highly modified scent-scales shaped like battledores, on the wings of certain butterflies and caddis flies (*Trichoptera*). In certain butterflies (*Thecla, Danais*, etc.) they occur on the upper side of the fore wings in limited areas, such as in the discal spots, or they may be scattered in rows or irregularly over the upper surface, or in the folds of the wings. Fritz Müller has shown that these minute scales function as scent-scales, and are confined to the males. Thomas has proved by sections of the wings of *Danais*, etc., that the androconia arise from glands situated in a fold of the wing, and that the material elaborated by the local glands, and distributed upon the surface of the wing by the androconia is that which gives to many of the *Lepidoptera* their characteristic odor. Scudder, who named them, says that they are very capricious in their occurrence. A number of allied genera may possess them, while a single genus, as closely allied, may be quite destitute. They occur in the *Nymphalidæ, Pieridæ, Lycæmidæ, Papilionidæ,* and *Hesperidæ.*

Andromachus, ăn-drŏm'ăk-ŭs, a physician to the Emperor Nero, and the inventor of a celebrated compound medicine called *theriake,* described in Galen's works.

Andronicus I., ăn'dro-nĭ'cŭs (Comnenus), a Byzantine emperor: b. 1110; d. 12 Sept. 1185. In his youth he served against the Turks, in 1141 was for some time a prisoner, and was afterward appointed to a military command in Cilicia, but was unsuccessful. Engaging in a treasonable correspondence with the king of Hungary, he was thrown into prison by his cousin, the Emperor Manuel: but after 12 years he succeeded in making his escape and reached Kiev, the residence of Prince Jaroslav. He regained the favor of his cousin by persuading Jaroslav to join him in the invasion of Hungary, and by his gallantry in that war: but again incurred his displeasure and was sent in honorable banishment to Cilicia. After a pilgrimage to Jerusalem and his scandalous seduction of Theodora, the widow of Baldwin, king of Jerusalem, he settled among the Turks in Asia Minor with a band of outlaws, making frequent inroads into the province of Trebizond; but at length made his peace with the emperor and was sent to Œnoe in Pontus. Upon the death of Manuel in 1182 he was recalled to become, first guardian, then colleague, of the young Emperor Alexius II. Soon after he caused the empress-mother to be strangled, and afterward Alexius himself, whose youthful widow he married. His reign, though short, was vigorous, and restored prosperity to the provinces; but tyranny and murder were its characteristics in the capital. At last a destined victim, Isaac Angelus, one of his relatives, having fled to the Church of St. Sophia for sanctuary, a crowd gathered, and a sudden insurrection placed Isaac on the throne, while Andronicus, now 73 years of age, was put to death by the infuriated populace after horrible mutilations and tortures.

Andronicus of Rhodes, a Roman philosopher who interpreted the works of Aristotle (q.v.). He lived in Cicero's time. None of his known works are extant.

Andropogon, ăn'dro-pō'gŏn, a genus of about 200 species of grasses of very diverse utility, distributed widely, especially over dry plains throughout the temperate and tropical zones. The species are usually characterized by long, narrow leaves; terminal and axillary spikes; sessile perfect spikelets paired with pedicelled staminate, empty ones or scales; and straight or twisted awns. *A. halepensis,* or *Sorghum halepense* of some authors, Johnson grass, attains a height of from 3 to 6 feet from stout, perennial creeping rootstocks, which being difficult to eradicate make the plant a troublesome weed where not needed for pasture or hay, for which it is largely grown in South America, Australia, and the southern United States, where it was introduced about 1830. It makes quick growth, yields abundantly, and may be cut several times in a season. It is not fully hardy in the north, where, as in Europe, it is often grown for ornament. *A. schoenanthus,* lemon grass, and *A. nardus,* citronella grass, are handsome tropical species cultivated in India and Ceylon for the fragrant oils they contain, and which are used in perfumery, soap-making, and in the former case for the adulteration of certain perfumes, notably attar of roses. *A. sorghum,* or *Sorghum vulgare* of some authors, is of wide economic importance, its numerous varieties or sub-species being cultivated for fodder, sugar, alcohol, brushes, brooms, and its seeds, which last are used for poultry, stock, and human food. (See Sorghum.) *A. provincialis, A. scoparius,* and various other species known as blue-stem grass, are valued as fodder grasses in arid regions where they are native.

Andros, Sir **Edmund,** an American colonial governor: born in London, England, 6 Dec. 1637; died there 24 Feb. 1714. His father was master of ceremonies to Charles I.; shared with distinguished service the Stuarts' exile, made his son a page, and put him early into the army of Henry of Nassau. His uncle was cupbearer to Charles' sister, the queen of Bohemia, and in 1660 Edmund was made her gentleman in ordinary. Her adviser in her widowhood was William, Earl of Craven, and Andros in 1671 married the sister of Craven's kinsman and heir. He earned the favor of the Stuarts by steady and laborious service, unwavering loyalty and honor, and a military and executive ability which was equally appreciated by their successors. In 1666 he was made major of an infantry regiment and sent to America, where he won laurels against the Dutch, and in 1672 was titular commander of the British forces in Barbados, with the reputation of being skilled in American affairs. At this time he was in England, and in April 1672 was made major in a regiment of dragoons raised for Prince Rupert; also a "landgrave" in Carolina, two years later succeeding his father as bailiff of Guernsey.

In 1674 Andros was made "lieutenant and governor" of "all the Duke of York's territories in America," including New York (just restored by the Dutch, who had retaken it the year before), New Jersey, and Delaware, Martha's Vineyard, and parts of Maine, and a claim to all Connecticut west of that river. He arrived in November, and the next year began to push the Connecticut claim; but the duke did not desire an appeal to force, and after making formal declarations at Saybrook, Andros retired. During the next two years the Indian troubles were acute; and he proved himself one of the ablest

and most useful of Indian managers, winning the good will of the Iroquois at a critical time, and not only keeping his own colony protected, but sending help to the outlying points in Rhode Island, Massachusetts, and Maine. He spent a few months in England in 1677–8, and was knighted. In 1678–80 there was increasing friction, religious and otherwise. He was an Episcopalian, and one of his appointees to a coadjutorship in an Albany church was tried for heresy, but acquitted; Andros, however, tactfully quieted the disturbance and contributed to build a Reformed church in New York. Then the merchants charged him with unfairness in trade matters, and with suppressing part of his receipts in his public accounts, with the object of inducing James to sell to some of them the right to farm the New York revenues. At this period Philip Carteret was acting as governor of East Jersey under the Duke of York's grant to his brother and Berkeley; there were complications inherited from previous changes which forced Andros to keep interfering, under his superior commission, and at last he sent a body of soldiers to seize Carteret and bring him to New York, to be tried for exercising illegal jurisdiction. Andros acted as judge, but the jury acquitted Carteret, who was triumphantly reinstalled. Lady Carteret complained to James, who recalled Andros, and sent out a commissioner to investigate this and the other charges: he reported that Andros was not in fault, but the latter was retained at home, made gentleman of the privy chamber to Charles II., and received a 99-years' grant of the island of Alderney and other favors.

The accession of James II. (February 1685), brought him a great though ill-starred position, which has loaded his memory with unjustifiable abuse. The Massachusetts charter had been vacated in October 1684, and Charles II. had appointed the notorious Col. Piercy Kirke governor; but as he never entered on his duties, Andros was commissioned governor of all New England as one consolidated colony on 3 June 1686. Dislike to James has done injustice to the scheme, which was statesmanlike, distasteful as it was to the New Englanders: to make one powerful province with a militia army strong enough to resist French and Indian aggression, and under one command, instead of several weak ones fighting each other rather than the common enemy. As to Andros, the plan was not his, there is no evidence that he sought the place, there was no reason why he should not accept it, and there was no way to execute it but the one he adopted: we cannot justify the end and blame the indispensable means. He could only be blamed for needless harshness or blundering or corruption in obeying his instructions: and despite the current opinion there was none of this, but rather the reverse. On arriving at Boston, 19 Dec. 1686, he organized his new government, which, as the people had no longer the right to tax themselves, levied a new tax, which, however, was exactly the same as the old. Ipswich refused to pay, and the ringleaders were fined and imprisoned, as must happen under any law. He was ordered to proclaim all land titles invalid unless confirmed by the Crown for a quit-rent. Outrageous as this may seem, it was held to be sound law, and he enforced it in the most humane way by bringing test suits against a few of the wealthiest citizens before proceeding further. As a fact, only a part had yielded when the Revolution interrupted it. He granted waste common-lands to individuals who would improve: a venial crime. Heavy fees were charged by the public officials; but he neither fixed the rates, received the proceeds, nor appointed the officers who did. He had Episcopal services held in the Old South Church, but only when its regular congregation was not using it; this sacrilege, however, has blackened his memory worse than anything else. He was sometimes sharp in speech; but when some wickedly foolish people charged him with secretly fomenting an Indian war, he only laughed at them and left the courts to attend to the matter. In a word, there was neither a political nor a religious reign of terror set up: no one was persecuted for nonconformity, or executed or whipped for political offenses. Andros behaved like a statesman, an honest man, and a humane one. He early extended his authority over Plymouth, New Hampshire, and Rhode Island, as well as Maine and Massachusetts. In October 1687 he visited Hartford, to take up the Connecticut charter: the story of its being hidden in the Charter Oak is classic, and it is certain enough that one copy was hidden and was efficient in restoring the charter rights of the colony later; but there was another copy and the event was of no significance at the time. Andros, on returning to Boston in 1688, received the news that he was made governor also of all the British provinces in America except Pennsylvania, Delaware, Maryland, and Virginia. While making a tour of his northern provinces he was checked by the information that the Penobscot Indians, stirred up by Castine (q.v.), whose property had been taken, were about to go on the war-path. He collected 700 troops, and in November proceeded to Maine and garrisoned several posts. On 4 April 1689 news was received of the deposition of James II.; on the 18th the citizens rose and captured Andros, and kept him prisoner till 2 August, when he escaped to New York, but was recaptured and brought back, and not released till February 1690. William III. needed officials as able and upright as he, and in 1692 made him governor of Virginia. He carried with him the charter of William and Mary College, and till 1698 remained in Virginia, a most public-spirited, hard-working, excellent ruler, doing much for the progress of the colony and esteemed by its people. His removal was caused by a quarrel with the commissary of the Bishop of London, and president of the college, who quarreled with all the governors. He was governor of Guernsey 1704–6, and bailiff of the island for life. He had been governor of every mainland English province in North America, and won the esteem of four successive monarchs, of hostile lines. Even for New England, his departure was not an unmixed good, for it was followed by one of her bloodiest and most disastrous Indian wars, which his presence might have averted.

An'dros Islands, a group of islands of the West Indies belonging to the English colony of the Bahamas, about 150 miles southeast of Florida.

Anemometer, ăn-e-mŏm'e-tėr (from the Greek words *anemos*, "wind," and *metron*, "measure"), an instrument for measuring the velocity of an air current, or the force such a current exerts against an obstacle. The two problems here suggested are widely different in nature; for while the *velocity* of an air current can easily be obtained with a fair degree of precision, the determination of the wind *pressure* exerted against buildings and other structures involves many considerations that cannot be overlooked without falsifying the results. The problem of wind pressure is so complicated, in fact, that the numerous forms of apparatus proposed for its solution are mostly unreliable, misleading, and incapable of furnishing even approximate values of the real forces in play. For further discussion of the force of the wind see WIND.

Of the numerous forms of anemometer proposed for the determination of the velocity of an air current, only two are in general use. These are (1) Robinson's, and (2) Casella's. The Robinson instrument is designed for meteorological use, and consists of four hemispherical cups, mounted upon horizontal arms, and capable of rotating freely about a vertical axis. The wind strikes the convex surfaces of the cups on one side of the axis of rotation, and the concave surfaces on the other side; and as it exerts more force against a concave surface than against an equal convex one, the system of arms and cups is caused to rotate continuously, with a speed depending upon the velocity of the wind. Dr. Robinson, the inventor of this type of instrument, concluded that the linear speed of the centre of the cups is one third of the velocity of the wind causing the rotation, but it is now certain that this ratio varies somewhat with the proportions of the arms and cups, and that the real velocity of the wind may be from 2.5 to 3.5 times as great as that of the centre of the cups. Before accurate results can be obtained from a Robinson anemometer of given proportions it is therefore necessary to determine the constant of this particular design of instrument experimentally, either by exposing it by the side of another instrument previously studied, or by whirling it through the air at the extremity of a revolving arm whose speed of rotation is known. The Robinson anemometer is the official instrument of the United States Weather Bureau for the measurement of wind-velocities.

The Casella anemometer is designed for measuring the velocities of air currents in mines, ventilating shafts, and like places. It consists essentially of a set of spokes radiating from an axis and each carrying at its extremity a small fan or blade, set at an oblique angle to the central shaft. The instrument is placed in the current whose velocity is to be measured, its axis of rotation being set parallel to the direction of flow of the air. The velocity of the current is determined by observing the number of revolutions made by the fan in a given time, as recorded upon a graduated dial whose index is actuated by the fan, through a suitable train of wheels. In some forms of the Casella anemometer a half-minute sand glass is provided, which, when inverted, automatically throws the recording needle into gear and out again. It is hardly necessary to add that the Casella instrument, like the Robinson, must be carefully tested by experiment, or by comparison with another instrument which has been so tested, before its indications can be considered reliable.

(See Abbe's 'Meteorological Apparatus and Methods,' also Prof. C. F. Marvin's paper in the 'Report, for 1890, of the Chief Signal Officer of the United States Army.')

Anemone, ă-nĕm'o-ne, wind-flower, a genus of plants belonging to the Buttercup family (*Ranunculaceæ*) containing many species found in temperate regions. Many of them occur in the United States, where their bloom whitens the fields in spring and summer. The most important are: *A. nemorasa*, the common wood-anemone; flowers white, externally tinged with purple; *A. patens mittalania*, the American Pasque flower; *A. quinquefolia*, *A. caroliniana*, and *A. narcissiflora*, found in mountainous regions.

An'eroid Barometer, a species of barometer in which no fluid is employed, an ingenious and delicate instrument invented by M. Vidi, of France, in 1844. Its mechanism consists of a hollow metal cylinder, with thin and corrugated ends, which contract or expand according to the pressure of the atmosphere, the air within having been previously exhausted by the air-pump. The motion of the ends of the cylinder acts upon a principal lever attached to it, and connected with two smaller levers, to one of which a chain is attached, working upon a roller, and to the axis of the roller a hand is fixed, exhibiting the variations of the atmosphere by means of an index on the face of the barometer. A pocket aneroid is very useful for measuring small heights. See BAROMETER.

An'eurism, a disease of the walls of the arteries resulting in the formation of a pulsating sac or swelling. At times the disease process leads to rupture of the walls of the blood-vessels with an extravasation of blood into the adjacent tissues, making a tumor-like formation. Such an aneurismal swelling is known as a false aneurism. In the true aneurism the sac is formed by one or more of the arterial coats. True aneurisms vary in shape and size, being fusiform, cylindrical, cirsoid (in which a branch of the artery is included in the swelling), circumscribed, or sacculated. Most aneurisms are fusiform, the dilatation of the vessel usually being uniform. Another type of aneurism usually occurring in the aorta is known as a dissecting aneurism. In this the inner wall of the artery ruptures and the blood dissects its way between the coats of the artery wall. When an aneurismal swelling occurs at the junction of an artery and a vein, an arterio-venous aneurism results. Aneurismal varix is a type of this form of aneurism.

The causes of aneurisms are manifold. The most important feature is a chronic disease of the connective tissue of the blood-vessels, arterio-sclerosis (q.v.) that results in the weakening of the wall and gradual distention of the vessel with the formation of a sac. The symptoms are often extremely obscure and depend in large part on the presence of a tumor that makes pressure symptoms on important organs. These will vary widely according to the situation of the aneurism. The treatment is largely surgical and the details are dependent upon the variety and situation of the aneurismal swelling.

Angel of the Battlefield. See ANTHONY, SISTER.

Angell, ăn'jĕl, **George Thorndike,** American reformer: b. Southbridge, Mass., 1823. He was graduated at Dartmouth College in 1846, and admitted to the bar in 1851. He has been active in promoting measures for the prevention of crime, cruelties, and the adulteration of food. He founded and is president of the American Humane Educational Society.

Angell, James Burrill, an American educator: b. in Scituate, R. I., 7 Jan. 1829. He was graduated from Brown University in 1849; and was professor of modern languages and literature there, 1853–60; editor Providence *Journal*, 1860–6; president of the University of Vermont, 1866–71; president of the University of Michigan since 1871. United States minister to China, 1880–1; minister to Turkey, 1897-8; member of the Anglo-American Commission on Canadian Fisheries, 1887, and of the Deep Waterways Commission, 1896. Author of 'Manual of French Literature' (1857); 'Progress in International Law' (1875); and many articles in the leading American reviews.

Angell, Joseph Kinnicut, an American legal writer: b. Providence, R. I., 30 April 1794; d. Boston, Mass., 1 May 1857. Graduated at Brown University, 1813. Edited the 'Law Intelligencer and Review,' 1829–31, and prepared the first published law reports of Rhode Island. Alone or in collaboration he produced a number of valuable and much used legal textbooks, chief of which are, 'Treatise on Corporations' (4th ed. 1858), highly commended by Chancellor Kent; 'Common Law in Relation to Watercourses' (4th ed. 1850); 'Liabilities and Rights of Common Carriers' (2d ed. 1845); 'Law of Fire and Life Insurance.'

Angelo, ăn'jĕlō, **Michael.** See MICHELANGELO.

Angelus, the Catholic prayer and practice by which the mystery of the Incarnation is recalled to mind and is honored, morning, noon, and evening. It forms the subject of a famous painting by Millet (q.v.).

Angi'na Pec'toris, a symptom of disordered heart action, frequently called a neurosis. It is a rare disease and is characterized by paroxysmal attacks of excruciating pain in the heart region. These pains frequently radiate into the arms and neck and sometimes are so severe as to cause a sense of suffocation and fear of death. It is a suffocative breast pang. True angina pectoris — for there are false varieties that occur largely in hysterical and neurasthenic women — often causes death, whereas the false variety is rarely as severe and never fatal. Men are more frequently affected than women, and it is a disease of adult life. It is sometimes found in families for several generations. Gout, syphilis, diabetes, excessive tea or coffee drinking, and even influenza are important factors in bringing about certain changes in the arteries, notably the coronary arteries of the heart, that are nearly always found as concomitants of this condition. This change of the arteries is a true arterio-sclerosis (q.v.). The attacks are usually brought on by sudden acute exercise, or by marked emotional excitement, notably worry and anger.

References.— Osler, 'Lectures on Angina Pectoris' (1897); Hoffman, 'Die Herzneurosen und die funktionellen Kreislaufstörungen' (1903).

An'gle, the point where two lines meet, or the meeting of two lines in a point. Technically, the inclination of two lines to one another. A plane angle is the inclination of two lines to one another in a plane, which two lines meet together. A solid or polyhedral angle is that made by the meeting in one point of more than two plane angles, which, however, are not in the same plane. A dihedral angle is formed by the intersection of two planes. Angles may again be subdivided into rectilinear, curvilinear, and mixed angles. A plane rectilinear angle is the inclination to each other of two straight lines which meet but are not in the same straight line. A curvilinear angle is the inclination to each other of two curved lines which meet in a point, and is equal to the inclination of the tangents to the curves at their intersection. A mixed angle is one formed by the meeting of a curve and a straight line.

Angles are measured by arcs, and it is immaterial with what radius the latter are described. The result is generally stated in degrees, minutes, and seconds $^{\circ}\ '\ ''$; thus $36^{\circ}\ 14'\ 23'' =$ 36 degrees, 14 minutes, and 23 seconds. Angles are also measured in radians, a radian being the arc equal to the radius of the circle, or about 57.3°. The quadrant, or right angle, is also a convenient unit for many purposes. When an angle is isolated from other angles it may be named by a single letter; but when two or more angles meet at one point they are named by three letters, never by one or two. In such cases the letter at that point is always named in the middle. The point at which the lines forming the angle meet is called the angular point or vertex of the angle, and the lines themselves are called the sides or legs of the angle.

Plane rectilinear angles are generally divided into right and oblique, or into right, obtuse, and acute. When a straight line standing upon another straight line makes the two adjacent angles (those on the right and left of it) equal to one another, each of them is called a right angle. An oblique angle is one which is not a right angle. An obtuse angle is that which is greater than one right angle, but less than two. An acute angle is that which is less than a right angle: both are oblique. A spherical angle is one formed by the intersection or the meeting of two great circles of a sphere.

An'gle Iron. See RAILS AND STRUCTURAL SHAPES.

An'gler. See GOOSEFISH.

An'gles, a German tribe who probably lived originally on the east side of the Elbe, between the Saale and Ohre rivers, whence they moved to what is now the district of Angeln in Schleswig-Holstein, lying between the territories of the Jutes and Saxons. They never approached the Rhine and the Roman frontiers, hence we do not find their name mentioned by the Roman authors, who comprehended them, with many others, under the general name of Chauci and Germani, till the conquest of Britain made them better known as a separate nation. In the 5th century they joined their powerful

northern neighbors, the Saxons, and took part in the conquest of Britain, which from them derived its future name of England. A part remained in their Continental homes and gave their name also to the district of Angeln.

Anglesey, ăn'gl'-sē, **Henry William Paget, Marquis of,** an English soldier and statesman: b. 1768; d. 1854. He was educated at Oxford, and in 1790 entered Parliament as member for the Carnarvon boroughs. In 1794 he took part in the campaign in Flanders under the Duke of York, and in 1808 was sent into Spain with two brigades of cavalry to join Sir John Moore, and in the retreat to Coruña commanded the rear guard. In 1812 he became, by his father's death, Earl of Uxbridge. On Napoleon's escape from Elba he was appointed commander of the British cavalry, and at the battle of Waterloo overthrew the Imperial Guard. For his services he was created Marquis of Anglesey. In 1828 he became lord-lieutenant of Ireland and made himself extremely popular, but was recalled in consequence of favoring Catholic emancipation. He was again lord-lieutenant in 1830; but lost his popularity by opposition to O'Connell and his instrumentality in the passing of the Irish coercion acts, and he quitted office in 1833.

Anglesey, ăn'gl'-sē, or **Anglesea,** an island and county of North Wales, in the Irish Sea, separated from the mainland by the Menai Strait. It is about 20 miles long and 17 miles broad, with an area of 175,836 acres, of which fully 150,000 acres are under rotation crops and permanent pasture, exclusive of mountain and heath land used for pasturage (about 7,600 acres). It is divided into three *cantrefs*, and each of these into two *cwmwds,* equivalent to the English hundreds. The surface of the island, with the exception of Holyhead, Parys, and Bodafon Mountains, is comparatively flat, and the climate, though milder than that of the adjoining coast, is not so favorable to the growth of trees. There are no streams of any importance, but the coast affords some natural harbors, the principal of which are Holyhead and Beaumaris. The principal crops are oats, barley, turnips, and potatoes. Cattle and sheep are the staple productions of the island, and large numbers of both are annually exported. Of minerals, Anglesey contains copper, lead, and silver ore, limestone, marble, asbestos, and marl, but the copper mines at Parys and Mona, once so celebrated and productive, have much decreased in value. The Menai Strait is crossed by a magnificent suspension-bridge, 580 feet between the piers and 100 feet above high-water mark, allowing the largest vessels which navigate the strait to sail under it; and also by the great Britannia Tubular Bridge, for the conveyance of railway trains, Holyhead being the point of departure for the Irish mails. The market towns are Holyhead, Beaumaris, Llangefni, and Amlwch, the first-named by far the largest. The county itself returns a member to Parliament. On the coast are several small islands, the chief being Holyhead and Puffin Island. Pop. (1901) 50,590.

An'glesite, ăn'gle-sīt (from the island of Anglesea, where it was first observed, a native sulphate of lead, $PbSO_4$. It crystallizes in the orthorhombic system and has a hardness of from 2.75 to 3, and a specific gravity varying from 6.1 to 6.4. It may be transparent or opaque, and in color white, greenish, yellowish, or gray. It occurs in many localities, usually in connection with galena, whence it is apparently derived by oxidation. Beautiful transparent crystals of it, several inches in diameter, are known. Anglesite, in a massive form, is extensively mined as an ore of lead (q.v.).

An'gleworm. See EARTHWORM.

An'glia, East, an English kingdom founded by the Angles (q.v.) in the 6th century in the eastern part of England in what now forms the present counties of Norfolk and Suffolk. It was conquered by the Danes in 878, and became part of the English kingdom in 921, under Edward, son and successor of Alfred. The modern see of Norwich corresponds in extent to the East Anglian kingdom, and the name East Anglia is still frequently employed to denote these two shires.

An'glican Church. See CHURCH OF ENGLAND.

An'glin, Margaret, an American actress: b. in Ottawa, Canada, 1876. She studied at the Empire School of Dramatic Acting in New York city and made her début in 1894 in 'Shenandoah.' Her roles include Roxane with Mansfield in 'Cyrano de Bergerac,' Mimi in 'The Only Way,' Mrs. Dane in 'Mrs. Dane's Defense,' and Mabel Vaughn in 'The Wilderness.'

An'gling is one of the words which have made themselves a specific meaning that has eluded the lexicographer, or nearly so. Of course it is, as he says, "to fish with an angle or rod and line and bait": but to those of the craft it is so much more and so much less. It is to fish in a certain way, and not with any rod and line and bait. When the real disciple of the gentle Izaak uses the words «Let us go angling,» it means Let us wander away with the lightest of bamboo rods, the multiplying reel, the thinnest and most perfect of lines, and a book full of artificial flies. Angling is for the knights of the craft, and for the kings of fighting fish.

After fixing the separate pieces of his rod together and attaching the winch on which his line is wound, the angler passes the line through the rings along the length of the rod, and through the loop at the top. He then attaches a length of gut, and on that he fastens the artificial-fly hook. After unwinding as much of the line as will be necessary to reach the spot on the water where he thinks the fish is, he is ready for the sport. There are two schools of fly-casters among anglers, the old-fashioned wet caster, who was not restricted to any number of flies, and who moved up or down the stream casting frequently as he went, and the modern school of dry casters who restrict themselves to a single artificial fly, made very small, dressed with upstanding wings, so as to ensure its floating on the surface, and sometimes anointed with an odorless oil to keep it dry. The dry caster remains inactive until the trout is seen to rise.

In either school the casts are divided into six classes: the overhand, the underhand, the spray cast, the wind cast, the flip cast, and the switch cast. The object of them all is to cause

the fly to fall upon the water as if it were a natural fly which had alighted on the surface in its natural habit, or had fallen off some overhanging branch, or been blown from the grass and was floating down stream. The most commonly used cast is the overhand. To perform it the angler standing on the river's brim unwinds a few yards of his line and lets the fly float down stream, raising his rod until it is at an angle of some 60 to 80 degrees in front of him. With a swift movement of the wrist, he lifts it so that it passes over his shoulder: the line follows and passes away beyond it. At a moment only to be learned from experience, but which every angler soon feels, he throws the rod forward and onward in the direction in front of him which he wants the fly to take, and it falls there, gently. This cast is possible wherever there are neither trees nor rocks for the necessary distance behind the angler. When these are present the switch cast is used: in that the fly is drawn along the top of the water toward the angler's feet, and then, lowering his rod by a quick downward movement, the line is sent forward rolling over and over itself in curves. When all the curves are unwound the fly falls back into the water at the extreme end of the line. The first movements in the wind cast are the same as those of the switch cast: the difference is in the thrash by which the line is made to travel up against the wind. The flip cast is made by taking the fly between the thumb and finger, pulling the top of the rod down until it is a bow, and then letting it slip back. The force will carry the fly to the desired spot. The spray cast is used now when a great length of line is out. The fly is then drawn up to the feet of the angler and the pole thrown forward up stream, not, as in the overhead cast, swished behind the line of the shoulders.

An'glo-Amer'ican Commission, a joint international commission appointed in 1898 by the United States and Great Britain for the negotiation of a plan for the settlement of all controversial matters between the United States and Canada. The subjects submitted for the consideration of the commission were officially determined as follows: "The Behring Sea sealing question, reciprocal mining regulations, the preservation of the fisheries of the Great Lakes, the North Atlantic fishery question, the boundary question, the alien labor laws, and reciprocity of trade." Lord Herschell, Sir Wilfred Laurier, Sir Richard Cartwright, Sir Louis H. Davies, and Mr. J. Charlton, a member of the Dominion Congress, were appointed British commissioners. The American commissioners were United States Senators Fairbanks and Gray, Congressman Dingley, Reciprocity Commissioner Kasson, and ex-Secretary of State Foster. The commission met at Quebec, 23 August, Lord Herschell being chosen chairman; W. C. Cartwright, of the Foreign Office, and H. Bourassa, member of Parliament for Labelle County, Quebec, were chosen British secretaries, and C. P. Anderson United States secretary. Later in the year an adjourned session was held in Washington, D. C., which adjourned without practical results.

An'glo-Amer'ican League, The, an organization formed 13 July 1898 at a meeting held at Stafford House, London. Its object is to give practical effects to the terms of the following resolution, passed at that meeting:

"Considering that the peoples of the British Empire and of the United States of America are closely allied in blood, inherit the same literature and laws, hold the same principles of self-government, recognize the same ideas of freedom and humanity in the guidance of their national policy, and are drawn together by strong common interests in many parts of the world, this meeting is of opinion that every effort should be made, in the interest of civilization and peace, to secure the most cordial and constant co-operation between the two nations."

Membership is open to all British subjects and citizens of the United States. A strong and representative committee was formed, with the Right Hon. James Bryce, M. P., as chairman.

An'glo-Cath'olic, a term applied to those members of the Anglican communion whose beliefs and religious forms most nearly approach those of the Roman Catholic Church. Ritualists, as Anglo-Catholics are frequently called, lay especial emphasis on the "Catholic principles" of apostolic succession, regeneration in baptism, the Eucharistic real presence, and the authority of tradition.

An'glo-Is'raelite The'ory, a peculiar belief as to English origins. It assumes that the English are descended from the lost 10 tribes of Israel; but the theory is untenable on any scientific grounds, for the tribes vanished through absorption in neighboring peoples and were not lost in any real sense. See Streator, 'The Anglo-Alliance in Prophecy, or the Promises to the Fathers' (1900).

Anglo-Japanese Treaties. The first treaty between England and Japan was signed 30 Jan. 1902. The text is as follows:

The Governments of Great Britain and Japan, actuated solely by a desire to maintain the status quo and general peace in the extreme East, being moreover specially interested in maintaining the independence and territorial integrity of the Empire of China and the Empire of Korea, and in securing equal opportunities in those countries for the commerce and industry of all nations, hereby agree as follows:

Article 1. The High Contracting Parties, having mutually recognised the independence of China and Korea, declare themselves to be entirely uninfluenced by any aggressive tendencies in either country. Having in view, however, their special interests, of which those of Great Britain relate principally to China, while Japan, in addition to the interests which she possesses in China, is interested in a peculiar degree politically, as well as commercially and industrially, in Korea, the High Contracting Parties recognise that it will be admissible for either of them to take such measures as may be indispensable in order to safeguard those interests if threatened either by the aggressive action of any other Power, or by disturbances arising in China or Korea, and necessitating the intervention of either of the High Contracting Parties for the protection of the lives and property of its subjects.

Article 2. If either Great Britain or Japan, in the defence of their respective interests as above described, should become involved in war with another Power, the other High Contracting Party will maintain a strict neutrality, and use its efforts to prevent other Powers from joining in hostilities against its ally.

Article 3. If in the above event any other Power or Powers should join in hostilities against that ally, the other High Contracting Party will come to its assistance, and will conduct the war in common, and make peace in mutual agreement with it.

Article 4. The High Contracting Parties agree that neither of them will, without consulting the other, enter into separate arrangements with another Power to the prejudice of the interests above described.

Article 5. Whenever, in the opinion of Great Britain or Japan, the above-mentioned interests are in jeopardy, the two Governments will communicate with one another fully and frankly.

Article 6. The present agreement shall come into effect immediately after the date of its signature, and remain in force for five years from that date. In case neither of the High Contracting Parties should have notified twelve months before the expiration of the said five years the intention of terminating it, it shall remain binding until the expiration of one year from the day on which either of the High Contracting Parties shall have denounced it. But if, when the date fixed for its expiration arrives, either ally is actually engaged in war, the alliance shall, ipso facto, continue until peace is concluded.

The second treaty was signed at London 12 Aug. 1905. The following letter explains its objects and purposes.

Despatch to his Majesty's Ambassador at St. Petersburg, forwarding a copy of the Agreement between the United Kingdom and Japan, signed at London, Aug. 12, 1905.

The Marquis of Lansdowne to Sir C. Hardinge

Foreign Office, Sept. 6, 1905.

Sir, — I inclose, for your Excellency's information, a copy of a new Agreement concluded between his Majesty's Government and that of Japan in substitution for that of Jan. 30, 1902. You will take an early opportunity of communicating the new Agreement to the Russian Government.

It was signed on Aug. 12, and you will explain that it would have been immediately made public but for the fact that negotiations had at that time already commenced between Russia and Japan, and that the publication of such a document whilst those negotiations were still in progress would obviously have been improper and inopportune.

The Russian Government will, I trust, recognise that the new Agreement is an international instrument, to which no exception can be taken by any of the Powers interested in the affairs of the Far East. You should call special attention to the objects mentioned in the preamble as those by which the policy of the contracting parties is inspired. His Majesty's Government believe that they may count upon the goodwill and support of all the Powers in endeavouring to maintain peace in Eastern Asia, and in seeking to uphold the integrity and independence of the Chinese Empire and the principle of equal opportunities for the commerce and industry of all nations in that country.

On the other hand, the special interests of the contracting parties are of a kind upon which they are fully entitled to insist, and the announcement that those interests must be safeguarded is one which can create no surprise, and need give rise to no misgivings.

I call your especial attention to the wording of Article II., which lays down distinctly that it is only in the case of an unprovoked attack made on one of the contracting parties by another Power or Powers, and when that party is defending its territorial rights and special interests from aggressive action, that the other party is bound to come to its assistance.

Article III., dealing with the question of Korea, is deserving of especial attention. It recognises in the clearest terms the paramount position which Japan at this moment occupies and must henceforth occupy in Korea, and her right to take any measures which she may find necessary for the protection of her political, military, and economic interests in that country. It is, however, expressly provided that such measures must not be contrary to the principle of equal opportunities for the commerce and industry of other nations. The new Treaty no doubt differs at this point conspicuously from that of 1902. It has, however, become evident that Korea, owing to its close proximity to the Japanese Empire and its inability to stand alone, must fall under the control and tutelage of Japan.

His Majesty's Government observe with satisfaction that this point was readily conceded by Russia in the Treaty of Peace recently concluded with Japan, and they have every reason to believe that similar views are held by other Powers with regard to the relations which should subsist between Japan and Korea.

His Majesty's Government venture to anticipate that the alliance thus concluded, designed as it is with objects which are purely peaceful and for the protection of rights and interests the validity of which cannot be contested, will be regarded with approval by the Government to which you are accredited. They are justified in believing that its conclusion may not have been without effect in facilitating the settlement by which the war has been so happily brought to an end, and they earnestly trust that it may, for many years to come, be instrumental in securing the peace of the world in those regions which come within its scope. — I am, &c.,

(Signed) Landsdowne.

The text is as follows:

Inclosure. Agreement between the United Kingdom and Japan, signed at London, Aug. 12, 1905.

Preamble. The Governments of Great Britain and Japan, being desirous of replacing the Agreement concluded between them on Jan. 30, 1902, by fresh stipulations, have agreed upon the following articles, which have for their object: —

(a) The consolidation and maintenance of the general peace in the regions of Eastern Asia and of India;

(b) The preservation of the common interests of all Powers in China by insuring the independence and integrity of the Chinese Empire and the principle of equal opportunities for the commerce and industry of all nations in China;

(c) The maintenance of the territorial rights of the High Contracting Parties in the regions of Eastern Asia and of India and the defence of their special interests in the said regions:

Article 1. It is agreed that whenever, in the

opinion of either Great Britain or Japan, any of the rights and interests referred to in the preamble of this Agreement are in jeopardy, the two Governments will communicate with one another fully and frankly, and will consider in common the measures which should be taken to safeguard those menaced rights or interests.

Article 2. If by reason of unprovoked attack or aggressive action, wherever arising, on the part of any other Power or Powers either contracting party should be involved in war in defence of its territorial rights or special interests mentioned in the preamble of this Agreement, the other contracting party will at once come to the assistance of its ally, and will conduct the war in common, and make peace in mutual agreement with it.

Article 3. Japan possessing paramount political, military, and economic interests in Korea, Great Britain recognises the right of Japan to take such measures of guidance, control, and protection in Korea as she may deem proper and necessary to safeguard and advance those interests, provided always that such measures are not contrary to the principle of equal opportunities for the commerce and industry of all nations.

Article 4. Great Britain having a special interest in all that concerns the security of the Indian frontier, Japan recognises her right to take such measures in the proximity of that frontier as she may find necessary for safeguarding her Indian possessions.

Article 5. The High Contracting Parties agree that neither of them will, without consulting the other, enter into separate arrangements with another Power to the prejudice of the objects described in the preamble of this Agreement.

Article 6. As regards the present war between Japan and Russia, Great Britain will continue to maintain strict neutrality unless some other Power or Powers should join in hostilities against Japan, in which case Great Britain will come to the assistance of Japan, and will conduct the war in common, and make peace in mutual agreement with Japan.

Article 7. The conditions under which armed assistance shall be afforded by either Power to the other in the circumstances mentioned in the present Agreement, and the means by which such assistance is to be made available, will be arranged by the naval and military authorities of the contracting parties, who will from time to time consult one another fully and freely upon all questions of mutual interest.

Article 8. The present Agreement shall, subject to the provisions of Article VI., come into effect immediately after the date of its signature, and remain in force for ten years from that date.

In case neither of the High Contracting Parties should have notified twelve months before the expiration of the said ten years the intention of terminating it, it shall remain binding until the expiration of one year from the day on which either of the High Contracting Parties shall have denounced it. But if, when the date fixed for its expiration arrives, either ally is actually engaged in war, the alliance shall, ipso facto, continue until peace is concluded.

In faith whereof, the undersigned, duly authorised by their respective Governments, have signed this Agreement, and have affixed thereto their seals.

Done in duplicate at London, the 12th day of August, 1905.

LANDSDOWNE,

His Britannic Majesty's Principal Secretary of State for Foreign Affairs.

TADASU HAYASHI,

Envoy Extraordinary and Minister Plenipotentiary of His Majesty the Emperor of Japan at the Court of St. James.

Thus it will be seen that whereas the first treaty referred to China and Korea exclusively, and only became operative upon the intervention of a third Power, the treaty which is superseded applies also «to the regions of Eastern Asia and of India,» and becomes operative when either party to the agreement becomes the object of wanton attack or aggression with respect to the special interests in the regions coming within the scope of the agreement. In effect this new treaty guarantees the *status quo* for very nearly the entire continent of Asia, of course omitting Turkey. England will have Japan's support to withstand any foreign aggression in Persia and Afghanistan or against India, while Japan has the offensive and defensive backing of England in the new relations which she occupies toward Asiatic countries. The terms of this treaty are eminently satisfactory to neutral nations in that they practically give the «open-door» to all and present vast permanent commercial opportunities. Many of the principles agreed upon and incorporated in the agreement were known before the Battle of the Sea of Japan.

An'gloman'ia, a term denoting undiscriminating imitation of everything English on the part of persons of other nationalities. In the United States it is applied to a recent fad of fashionable society.

An'glo-Sax'on, the name given by modern historians to the Angles, Jutes, and Saxons who migrated to Britain from Germany in the 5th and 6th centuries A.D. They emigrated from the districts about the mouths of the Elbe and Weser, and the first body of them who gained a footing in England are said to have landed in 449, and to have been lead by Hengist and Horsa. The Jutes settled chiefly in Kent, the Saxons in the southern and middle country, and the Angles in the northern. Among the various Anglo-Saxon states that afterward arose those founded by the Angles first gained the preponderance, and gave to the whole country the name of *Engla-land*, that is, the land of the Angles.

Among the Anglo-Saxons we find the English constitution already existing in all its essentials, but its origin is not to be attributed to Alfred, though he brought it to a greater pitch of completeness. In a rudimentary form it was the common property of the Germanic peoples before the emigration of the Saxons and Angles from the Continent. It developed itself more independently, however, among the Anglo-Saxons than among those Teutonic races who came into closer connection with the Romans, and afterward with the Roman hierarchy. The Anglo-Saxon community was frequently spoken of as consisting of the *eorls* and the *ceorls*, or the nobles and common freemen. The former were the men of property and position, and were themselves divided into different ranks;

the latter were the small landholders, handicraftsmen, etc., who generally placed themselves under the protection of some nobleman, who was hence termed their *hlaford* or lord. Besides these there was the class of the serfs or slaves (*theowas*), who might be either born slaves or freemen who had forfeited their liberty by their crimes, or whom poverty or the fortune of war had brought into this position. They served as agricultural laborers on their masters' estates, and though mere chattels, as absolutely the property of their master as his cattle, their lot does not appear to have been very uncomfortable. They were frequently manumitted by the will of their master at his death, and were also allowed to accumulate savings of their own, so as to be able to purchase their freedom or that of their children.

One of the peculiar features of Anglo-Saxon society was the *wergyld*, or life-price, established for the settling of feuds. "A sum, paid either in kind or in money where money existed, was placed upon the life of every freeman according to his rank in the state, his birth, or his office. A corresponding sum was settled for every wound that could be inflicted upon his person; for nearly every injury that could be done to his civil rights, his honor, or his domestic peace; and further fines were appointed according to the peculiar adventitious circumstances that might appear to aggravate or extenuate the offense. From the operation of this principle no one was exempt, and the king as well as the peasant was protected by a wergyld, payable to his kinsmen and his people" (Kemble, 'Saxons in England').

The king (*cyning, cyng*) was at the head of the state; he was the highest of the nobles and the chief magistrate. He was not looked upon as ruling by any divine right, but by the will of the people, represented by the *witan*, or Great Council of the nation. Accordingly we find that the new king was not always the direct and nearest heir of the late king, but one of the royal family whose abilities and character recommended him for the office. The king was invested with certain honors and privileges in order that he might maintain his position with becoming dignity. Besides his wergyld as an ætheling or person of royal blood, his life was further guarded by a sum of equal amount, called *cynebót*, or price of royalty, and the former sum was to be paid to his relations, the latter to the people. As king he held possession of the Crown lands, which were national property, distinct from any private estates he might himself purchase. Among other privileges he was entitled to a portion of the fines and confiscations laid upon offenders; he had the right of maintaining a standing army of household troops, the duty of calling together the Council of the Witan, and of laying before them measures which concerned the welfare of the state, with certain distinctions of dress, dwelling, etc., all his privileges being possessed and exercised by the advice and consent of the *witena-gemót*, or Parliament.

The queen also was held in high honor. She sat by the king in the assemblies, and she possessed a separate establishment from that of the king, though on a smaller scale. Next in rank and dignity to the king were the *ealdormen*. These were at the head of the administration of justice in the shires, possessing both judicial and executive authority, and had as their officers the *scir-geréfan*, or sheriffs. One of their most important functions was the leading of the armed force of the county, a duty which often fell to their share during the period of the Danish invasions. The ealdorman, as such, held possession of certain lands attached to the office, and he was also entitled to a share of fines and other moneys levied for the king's use and passing through his hands. "Thus the position which his nobility, his power, and his wealth secured to the ealdorman was a brilliant one. In fact, the whole executive government may be considered as a great aristocratical association, of which the ealdormen were the members, and the king little more than the president. They were in nearly every respect his equals, and possessed the right of intermarriage with him; it was solely with their consent that he could be elected or appointed to the Crown, and by their support, co-operation, and alliance that he was maintained there. Without their concurrence and assent, their license and permission, he could not make, abrogate, or alter laws; they were the principal witan or counsellors, the leaders of the great gamót or national inquest, the guardians, upholders, and regulators of that aristocratical power of which he was the ultimate representative and head" (Kemble, Vol. II., p. 142).

Under the Danish kings the ealdorman fell into a subordinate position, the eorl or earl taking his place in the county. The ealdorman and the king were both surrounded by a number of followers called *thegns* or thanes, bound by close ties to their superior. The king's thanes were the higher in rank, and formed a kind of nobility by themselves. They possessed a certain quantity of land, smaller in amount than that of an ealdorman, and filled offices connected with the personal service of the king or with the administration of justice. According to Leppenberg they were in all respects the predecessors of the Norman barons. We frequently hear of a class of functionaries called *geréfan* or reeves, such as the *scir-geréfa* (shire-reeve or sheriff), the *port-geréfa* (port-reeve), the *tun-geréfa* (farm-reeve or bailiff; Scotch, *grieve*). These, of course, had different duties to perform, those of the shire-reeve being the most important. He presided at the county court along with the ealdorman and bishop, or alone in their absence; and had to carry out the decisions of the court, to levy fines, collect taxes, etc. In virtue of his office he had a portion of land allotted to him, hence called reeve-land. The shires were divided into hundreds and tithings, the former being equal to 10 of the latter. The tithing consisted of 10 heads of families, jointly responsible to the state for the good conduct of any member of their body. For the trial and settlement of minor causes there was a hundred court held once a month. The place of the modern Parliament was held by the *witena-gemót*, the representative council of the nation. Its members, who were not elected, comprised the æthelings or princes of the blood royal, the bishops and abbots, the ealdormen, the thanes, the sheriffs, etc.

Agriculture, including especially the raising of cattle, sheep, and swine, was the chief occupation of the Anglo-Saxons. Large tracts of the marshy land in the east of England were embanked and drained by them and brought

into cultivation. Gardens and orchards are frequently mentioned, and vineyards were common in the southern counties. The forests were extensive, and valuable both from the mast they produced for the swine and from the beasts of the chase which they harbored. Hunting was a favorite recreation among the higher ranks, both lay and clerical. Fishing was largely carried on, herrings and salmon being the principal fish caught. The whale fishery was also pursued, when the Anglo-Saxon vessels used to go as far as Iceland. The manufactures were naturally of small moment. Iron was made to some extent, and some cloth, and salt works were numerous. In embroidery and working in gold, however, the English were famous over the continent, and very elegant specimens of gold work have come down to our times. There was already a considerable trade at London, which was frequented by Normans, French, Flemings, and the merchants of the Hanse towns. The Anglo-Saxon forefathers were notorious for their excessive fondness for eating and drinking, and in this respect formed a strong contrast to the Normans who invaded the country. Ale, mead, and cider were the common beverages, wine being limited to the higher classes. Pork was a favorite article of food, and so were eels, which were kept and fattened in eel ponds and sometimes paid as rent. The houses were rude, ill-built structures, mostly of wood and without proper chimneys, but were often richly furnished and hung with fine tapestry. The dress of the Anglo-Saxons was loose and flowing, the materials being linen, woolen, and also silk; and their garments were often adorned with embroidery. The men looked upon the hair as one of their chief ornaments, and wore it long and flowing over their shoulders, while they also usually wore beards.

Christianity was introduced among the Anglo-Saxons in the end of the 6th century by St. Augustine, who was sent by Pope Gregory the Great and became the first Archbishop of Canterbury. Kent, then under King Ethelred, was the first place where it took root, and thence it soon spread over the rest of the country. It must, of course, be remembered that the Britons and Scots had already embraced Christianity, and missionaries from these labored in the conversion of the Anglo-Saxons. Monasteries were founded at an early period and became numerous. For a time the Anglo-Saxon Church maintained customs different in discipline from Rome, but uniformity was established in 670 by Theodore, the Archbishop of Canterbury. Many Anglo-Saxon ecclesiastics were distinguished for learning, but the Venerable Bede holds the first place. St. Boniface, the apostle of Christianity to the Germans, was an Anglo-Saxon.

An'glo-Sax'on Lan'guage, the oldest form of modern English, is the name generally given to the tongue spoken in Britain by its Teutonic settlers and invaders of the 5th and following centuries. The term Old English, though much to be preferred to Anglo-Saxon, has not yet met with general acceptance. The Anglo-Saxon belongs to the Teutonic branch of the Indo-European family of languages, which includes also the German, Dutch, Flemish, and Scandinavian tongues, and the oldest representative of which is the Gothic. The invading tribes spoke substantially the same language, though with marked differences of dialect, and this common tongue seems to lie midway between the Friesic and Old Saxon. The Angles settled in the north and east of Britain; the Saxons possessed themselves of most of the south and southwest; and the Jutes (numerically by far the smaller portion) established themselves in the southeast, chiefly in Kent and Surrey. Four distinct speech divisions arose: the two Anglian dialects, Northumbrian, spoken between the Humber and the Forth, and Mercian or Midland, spoken between the Thames and the Humber; the Saxon, spoken generally south of the Thames, except in Kent and Surrey; and Kentish, spoken in Kent and Surrey. The poems brought from the Continent were first written down in the Northumbrian dialect, and, indeed, most of the poetry composed in England seems to have been Northumbrian also. The Danish invasions destroyed the Northumbrian literature in great part; but during the West Saxon supremacy, in the great literary revival headed by King Alfred in the 9th century, the old poems were copied in the West Saxon dialect, and we know them only in that form.

The following are the chief features of the grammar of Anglo-Saxon, which was a synthetic language, in contradistinction to Modern English, which is analytic, or uninflected:

The Anglo-Saxon alphabet was the Latin with modifications made by English scribes. The letters F, G, R, and S, however, were quite unlike the usual forms. For two English sounds, W and TH, there were no convenient Latin signs, so two letters were adopted from the old Runic alphabet: Ƿ wēn, þ thorn; ð (edh) is a crossing of the Roman *d*. The most of the older editions of Anglo-Saxon texts have been printed with type made in imitation of the manuscript characters. In modern editions, the Roman characters are almost universally preferred, with the addition of ð, þ, and ȝ (representing G).

Pronunciation.— In general the vowels were pronounced as in modern German; the following table gives the approximate sounds:

a	as in	*a*sk (short).
ā	"	f*a*ther.
æ	"	m*a*n.
ǣ	"	th*e*re.
e ę	"	m*e*n.
ē	"	th*e*y.
i	"	h*i*t.
ī	"	s*ee*.
o ǫ	"	n*o*t
u	"	f*u*ll.
ū	"	r*u*le.
y	"	*i*t.
ȳ	"	s*ee*.

The diphthongs *ie*, *īe*, *ea*, *ēa*, *eo*, *ēo*, *io*, *īo*, receive the stress upon the first element.

The consonants *b*, *d*, *f*, *l*, *m*, *n*, *p*, *r*, *s*, *t*, *w*, *x*, *z*, were like mod. Eng. equivalents.

c had two sounds: as *c* in *cat*, and *k* in kink; *g* as in *go*, but in *ge*, *gi* it was pronounced as *y* in yet; *gea*, *gia* pronounced like *ya* in *yard*.

Phonology.— One of the commonest phenomena of Anglo-Saxon, as of German, is what is called *mutation*, or sometimes by the German name *umlaut*. M. in general is the influence exercised by a vowel on a vowel of the preceding syllable by which the first vowel is modified in the direction of the second, the result being a new vowel intermediate to the other two. The change may also be produced by a consonant in a succeeding syllable. For example the following changes are mutations:

A	to	Ę	as in	*mann* (man), plur. menn.
EA	to	IE	"	*eald* (old), *ieldra* (older).
U	to	Y	"	*burg* (city), plur. *byrig*.
Ō	to	Ē	"	*sōhte* (sought), *sēcan* (to seek).
ĒO	to	ĪE	"	*steor* (rudder), *stīeran* (steer).

Gradation (German *ablaut*) is the name given to a distinct vowel variation by which a root may appear in two or more forms even in the inflection of a single word: for example, *begin, began, begun.* Modern English *write, wrote, written* corresponds stem for stem to Anglo-Saxon *wrītan, wrāt, writen*, Anglo-Saxon ī and ā having become Modern English *ai* (written ī), and ō, short *i*, being preserved. Gradation is important because it is the characteristic means of distinguishing tense in the Anglo-Saxon strong verb.

Grammar.— There are three genders in Anglo-Saxon, masculine, feminine, and neuter, but they are grammatical rather than natural in their dependence; for example *wīf* (wife) is neuter; *sunne* (sun) is feminine; *mona* (moon) is masculine. Of most words the gender can only be learned by practice. There are four cases: nominative, genitive, dative, and accusative. The accusative and nominative are the same in all plurals, in the singular of all neuter nouns, and of all strong masculines. The dative plural of nearly all nouns ends in -*um*.

There are two schemes of noun inflection: the strong (or vowel) declension, and the weak (or neuter) declension. Weak nouns form their inflection with *n;* all others are strong. The following shows typical examples of each:

Strong Declension.

Masc.	Fem.	Neut.
Singular.	sing.	sing.
N. A. stān *(stone).*	N. giefu *(gift).*	N. A. scip *(ship).*
G. stānes.	G. D. A. giefe.	G. scipes.
D. stāne.		D. scipe.
Plural.	Plural.	Plural.
N. A. stānas.	N. A. giefa.	N. A. scipu.
G. stāna.	G. giefena.	G. scipa.
D. stānum.	D. giefum.	D. scipum.

Weak Declension.

Masc.	Fem.	Neut.
Singular.	Singular.	Singular.
N. nama *(name).*	sunne *(sun).*	N. A. ēage *(eye).*
G. D. A. naman.	sunnan.	G. D. ēagan.
Plural.	Plural.	Plural.
N. A. naman.	sunnan.	N. A. ēagan.
G. namena.	sunnena.	G. ēagena.
G. namum.	sunnum.	D. ēagum.

Adjectives also have three genders, the same cases as nouns, though with somewhat different endings, and a strong and a weak inflection. In the masculine and neuter singular they have an instrumental case for which in the feminine and plural and in the Weak inflection the dative is used. The Strong and Weak inflections are employed according as the adjectives are respectively Indefinite or Definite. The weak forms are used when the adjective is preceded by a demonstrative; the comparatives always, and superlatives usually, follow this declension, which agrees throughout with the weak declension of nouns, except that the genitive plural often ends in *-ra.* The strong declension is used when none of the conditions for the use of the weak declension are present, and with few exceptions it agrees with the strong declension of nouns.

The pronouns are peculiar in that they have a dual number: for example, N. *wit* (we two), N. git (*ye two*): Gen. *uncer, incer;* Dat. and Acc. *unc, inc,* respectively.

The verb had a single inflected voice, two tenses, two complete modes, besides an imperative in the present tense only; two numbers, three verbal nouns, the infinitive, the present, and the past participle. The verbs are divided into two classes: (1) those which form their principal parts with a variation of the root vowel (strong verbs), and (2) those which form the preterite and the past participle by the addition of *d* (-ode, -ede, -de) to the root syllable (weak verbs). The following is the conjugation of the strong verb *bindau* (bind), and shows the endings common to all verbs:

		Indicative.		Subjunctive.
Pres. sing.	1.	bind-e.		bind-e.
	2.	bind-est, bintst.		bind-e.
	3.	bind-e*þ*, bint.		bind-e.
plur.		bind-a*þ*.		bind-en.
Pret. sing.	1.	band.		bund-e.
	2.	bund-e.		bund-e.
	3.	band.		bund-e.
plur.		bund-on.		bund-en.
Imper. sing.		bind.	*Infin.*	bind-an.
plur.		bind-a*þ*.		
Partic. pres.		bind-ende;		
pret.		ge-bund-en.		
		Gerund. tō bind-enne.		

For the future tense the present is used, and periphrastic tenses are sometimes formed as in Modern English by *haebbe* (have) and *haefde* (had) with the past participles. The passive is formed with *wesan* (to be) or *weorþan* (become) with the past participle. These forms are extremely vague, but *wesan* seems to indicate a state, *weorþan* an action. The subjunctive is used to express wish, conditions, doubt, etc.

The order of words in Anglo-Saxon strongly resembles that of German, the verb coming before its nominative when the sentence is headed by an adverb or adverbial group, or when the object or predicate is put at the head of the sentence. In principal sentences there is a tendency to put the verb at the end, or at least to bring it near the end.

BIBLIOGRAPHY.— *General.*— O. F. Emerson's 'History of the English Language' (1897), and T. N. Toller's 'Outlines of the History of the English Language' (1900) will be found useful. For exhaustive bibliography of Anglo-Saxon language and literature see Körting's 'Grundriss der Geschichte der Englischen Litteratur) (3d ed. 1899), and R. P. Wuelker's 'Grundriss zur Geschichte der Angelsächsischen Litteratur' (1885).

Grammars.—'Angelsächsischer Grammatik von E. Sievers' (1886), English translation by A. S. Cook (2d ed. 1899); P. J. Cosign, 'Altwestsächsische Grammatik' (1883–8); F. A. March, 'Comparative Grammar of the Anglo-Saxon Language' (1870). There are excellent grammatical introductions to the 'Anglo-Saxon Readers' of H. Sweet (7th ed. 1897), and J. W. Bright (3d ed. 1894). Grimm's 'Deutsche Grammatik' (1840), E. Maetzner's 'English Grammatik' (3d vol., 3d ed. 1880), are indispensable for the advanced student.

Dictionaries.— Bosworth's 'Dictionary of the Anglo-Saxon Language,' edited and enlarged by T. N. Toller (1882–1900); H. Sweet's 'Student's Dictionary of Anglo-Saxon' (1897); J. R. C. Hall's 'Concise Anglo-Saxon Dictionary' (1894); and Vols. III. and IV. of Grein's invaluable 'Bibliothek der Angelsächsischen Poesie' (1861-4).

W. N. C. CARLTON,
Librarian Trinity College.

An'glo-Sax'on Literature, the term given to the literary remains of the English people from their earliest settlement in Britain to about 1100 A.D. It possesses a peculiar interest and importance because it is the oldest of the vernacular literatures of modern Europe. Its beginning, so far as it can be treated chronologically, lies between 658–680, the years of the abbacy of Hild at Whitby. Its oldest fragments give us a close view of the social conditions of the heathen Germanic age. Poetry antedates prose and was first cultivated in the north, in the Anglian kingdom of Northumbria more particularly. Later, when Northumbria lost her supremacy, and the kingdom of Wessex under Alfred rose to political leadership, the literary pre-eminence also was transferred to the latter. There are therefore two periods of Anglo-Saxon literature: the Anglian and the Saxon. The first produced only poetry; the second was largely a period of recasting and imitation, but possesses an independent interest in that it raised Anglo-Saxon prose to its highest point of efficiency as a literary vehicle. Practically all the poetry has come down to us only in its West Saxon dress, the Northumbrian originals being almost wholly lost.

Anglo-Saxon Versification.— Anglo-Saxon poetry is composed in a kind of blank verse, in unrimed, ungrouped, but alliterative lines. Every line consists of two parts, or half-lines, separated by a cæsura and united by alliteration; for example:

"Mē *s*ęndon tō thē ‖ *s*æmęn *s*nelle,
hēton the *s*ęcgan ‖ thæt thu most *s*ęndan **rathe**
*b*eagas with ge*b*eorge. ‖ and ēow *b*ętere is
thæt *g*e thisne gārrǣs ‖ mid **gafole** forgyldon,
thonne wē swā *h*earde ‖ *h*ilde dǣlon.

Maldon, ll. 29-33.

1. "Me have sent to thee — the seamen swift:
2. They bade to thee say — that thou must quickly send
3. Bracelets for safety; — and to you it better is
4. That ye the spear-rush — with tribute buy off,
5. Than that we so hard — a battle shall deal out."

Every half-line has two rhythmical accents (stresses), and two rhythmical measures (feet); it is a structural unit having a scansion of its own independent of the complementary half-line. In its simplest form the measure (foot) consists of two parts, an accented and an unaccented. Alliteration,— that is, the riming of the initial sounds of words or syllables, is employed to unite the two half-lines into the larger rhythmical unit of the complete line. It is confined to rhythmically accented syllables. Alliterating syllables have the same initial consonant (*st, sp, sc* alliterate each with itself only), or they have an initial vowel sound, any vowel or diphthong whatever alliterating with itself or with any other vowel sound. The rhythmical accentuation coincides in general with the accentuation required by the sense. The four chief stresses of a complete line therefore fall upon the four most significant words or syllables of that line. *Cf.* Siever's 'Altgermanische Metrik' (Halle 1893), and his article in Paul's 'Grundriss der Germanischen Philologie,' Vol. II.

Poetry.— The epic of 'Beowulf,' the oldest extant heroic poem in any Germanic tongue, celebrates the deeds of a Swedish hero of that name, particularly his victory over a man-eating monster called Grendel, and his final victory, which costs him his life, over a fiery dragon. The material is mythical and heathen, and the scene is laid in Denmark and southwest Sweden. Discussion as to its origin, date, and composition has become the "Homeric question" of Anglo-Saxon scholars. In many respects the most satisfactory theory regarding it is still that of Benjamin Thorpe: "From the allusions to Christianity I do not hesitate to regard it as a Christian paraphrase of a heathen saga, and those allusions as interpolations of the paraphrast, whom I conceive to have been a native of England of Scandinavian parentage." It is unquestionably a genuine production of the time when the old heathen tales still had their traditional interest, even though the Saxons had become thoroughly converted to Christianity. It was edited at an Anglian court, and the text took substantially the shape in which it has come down to us about the beginning of the 8th century. The poem is preserved in but one manuscript (Cott. Vitt. A. XV.) in the British Museum, which, according to palæographers, dates from the 10th century.

Cædmon, a Northumbrian herdsman of the 7th century, is the reputed author of some metrical paraphrases of the Old Testament. The so-called "sacred epics" include paraphrases of portion of Genesis, Exodus, and Daniel. In the manuscript volume containing them are fragments of three other poems relating to (1) the fall of the angels, (2) Christ's descent into hell, and (3) his temptation in the wilderness. The Exodus is the work of a true poet, but modern criticism has shown that the various portions of the "Cædmon poetry" exhibit differences of style inconsistent with the supposition of a common authorship. The most probable conclusion seems to be that Cædmon's rude Northumbrian verses were regarded by the writers of King Alfred's age as raw material which they worked over with unequal degrees of poetic skill. The poems are preserved in a 10th century manuscript in the Bodleian Library. Printed editions are: Junius' (1655); Thorpe's (London 1832); Boutewek's (2 vols. Gutersloh, 1849–54); and in the Grein-Wülker 'Bibliothek der Angelsächsischen Poesie.'

Cynewulf, like Cædmon, was a Northumbrian, but we have no certain knowledge of the time or place at which he lived. The certain works of his composition are the 'Legend of St. Guthlac,' 'Legend of St. Juliana,' 'Christ,' 'Andreas,' 'Elene,' the 'Fortunes of the Twelve Apostles,' and some 'Riddles.' Kemble first discovered that the runes in the 'Riddles,' 'Christ,' 'Juliana,' and 'Elene' gave the name Cynewulf, and thus recognized the name of their author. The Cynewulf poems show us the artist with whom Christian ideas have become native and spontaneous, and who disposes like a master of the rich legacy of epic diction and perception. Shorter poems and fragments whose material dates from the earliest times, and careful study of which throws much light upon Anglo-Saxon manners and cast of thought, are: 'Widsith' (the far-traveler), 'Lament of Deor,' 'The Scop' (Gleeman), 'The Wanderer,' 'The Departed Soul's Address to the Body,' and 'Waldhere.' The 'Wanderer' is thoroughly representative of the lyrics produced during the Anglian period. Of West Saxon composition and much later date are the two fine battle-pieces inserted in the Anglo-Saxon chronicle: 'The Battle of Brunanburh'

and 'The Battle of Maldon.' In the latter the relation between a lord and his men is seen under the severest test; the former throbs with patristic enthusiasm.

Prose.— With the accession of Egberht (800) Wessex began to take rank as the leading power in Britain. King Alfred (871–901) pushed this movement forward, and through his successive repulses of the Danish invasion made it an established fact. His services to literature and education were no less important. Knowledge of Latin having apparently died out in England, Alfred himself began translating important and helpful works into his native tongue, and unceasingly encouraged the learned men of his court and clergy to similar efforts. He revived interest in keeping the national annals; and the 'Anglo-Saxon Chronicle,' in the form in which it has come down to us, was the result. For the years of his reign it is of great value historically. (For his translations, etc., see ALFRED.) He was, in truth, the first to give his people a national prose literature.

Besides the compilation of laws made by Alfred there is extant a large body of legal documents such as grants of land, purchases, memorials, wills, royal writs, etc., extending from the 7th to the 12th century. At first all were entirely in Latin; then a few Anglo-Saxon words crept in, and then the native element goes on increasing until we have entire documents in Saxon. This literature fills six volumes of Kemble's 'Codex Diplomaticus.'

The religious prose forms an extensive portion of Anglo-Saxon literature, comprising translations of parts of the Old Testament and of the Gospels in the New, large collections of homilies, and almost all the work of Ælfric (q.v.) and Wulfstan. The period of literary productivity initiated by Ælfric was practical and popular rather than scholarly. It produced chiefly homilies, lives of the saints, translations, and service books. But all had a direct effect upon the people and language, and the mere existence of this literature proves that the English clergy were neither so ignorant nor so idle as sometimes represented.

Other writings deserving mention as showing the variety of the literature are: the translation of the late Greek romance, 'Apollonius of Tyre' in flowing English by a skilful pen; an English 'Herbarium' of the first half of the 11th century, which analyzes the medicinal uses of plants, and another work treating similarly of animals. 'The Læce Boc' (Leech Book) is a remarkable and comprehensive collection of medical prescriptions and recipes for the most diverse diseases, whose causes are also touched upon. ('Leechdoms, Wortcunning, and Starcraft of Early England.' Ed. by O. Cockayne, 2 vols. Lond. 1864–6.)

Bibliography.— For elaborate surveys of the literature relating to Anglo-Saxon language and literature see Wülker, 'Grundriss zur Geschichte der Angelsächsischen Litteratur' (1885); Korting, 'Grundriss der Geschichte der Englischen Litteratur' (3d ed. 1899). For histories of the literature see H. Morley, 'English Writers,' Vols. I., II.; Ten Brink, 'Early English Literature,' translation by Kennedy (1883); Earle, 'Anglo-Saxon Literature' (1884); Brooke, 'History of Early English Literature' (1899).

W. N. C. CARLTON,
Librarian Trinity College.

Angora, or **Engour** (the ancient ANCYRA), a town of Asiatic Turkey; 215 miles east of Constantinople, with which there is now railway communication. It has ruinous walls, and there are some remains of Byzantine architecture belonging to the ancient city, and a few relics of earlier times, both Greek and Roman. Among the latter are the remnants of the Monumentum Acyranum, raised in honor of the Emperor Augustus, who much embellished the ancient city. Angora is celebrated for the long-haired goats bred in its vicinity called by the Arabs the chamal goat, meaning "silky or soft." Goat's hair forms an important export; other exports being goats' skins, dyestuffs, principally madder, and yellow berries; mastic, tragacanth, and other gums; also honey and wax. British manufactures are imported to some extent. Estimated pop. 35,000.

Ango'ra Cat. See CAT.

Ango'ra Goat. See GOAT.

Anhy'drid, ăn-hī'-drĭd (from a Greek word signifying "without water"), an oxid which produces an acid when it combines with water, or which is obtained by removing water from an acid. Oxids which yield salts by combining directly with other more basic oxids may also be classed as anhydrids. The oxids of most of the non-metallic elements are anhydrids.

Anhydrite, a mineral having the composition of calcium sulphate, $CaSO_4$, and differing from gypsum in its lack of water. In its common white, massive form it much resembles the snowy-white gypsum (q.v.), but is readily distinguished by its superior hardness, 3 to 3.5. Anhydrite also occurs in orthorhombic crystals and in cleavable-lamellar and fibrous masses. Its colors are very varied, white or gray being the most common, but blue and even brick-red not being uncommon. It is brittle, breaking with an uneven or splintery fracture, or when crystallized, cleaving with ease into rectangular chips. Its lustre is also very varied, the crystals appearing pearly, greasy or vitreous according to the faces examined.

Ani, ä'ne, a lustrous blackbird (*Crotophaga ani*), of Florida, the West Indies, and tropical America, which is one of the cuckoo family.

Aniline, an'i-lin, an organic substance, discovered by Unverdorben in 1826, but of no commercial importance until W. H. Perkin prepared a purple dye from it in 1856. Since that time aniline and its derivatives have been used in great quantities for the preparation of the aniline dyes, of which a great number are now known. (See COAL-TAR COLORS.) Aniline, in its chemical aspect, is an amine of the organic radical "phenyl," C_6H_5, with the formula $C_6H_5NH_2$. (See AMINE.) It may be prepared from benzene, C_6H_6, by the action of nitric acid and (subsequently) a reducing agent. Thus the effect of nitric acid upon benzene is represented by the following equation:

$$C_6H_6 + HNO_3 = C_6H_5.NO_2 + H_2O.$$

The compound $C_6H_5.NO_2$, known as nitrobenzene, is a yellow liquid, boiling at 400° F. By the action of nascent hydrogen (which may be conveniently generated by adding acetic acid

and iron filings) nitro-benzene is converted into aniline, hydrogen being substituted for the oxygen in the group NO_2. The equation is:

$$C_6H_5.NO_2 + 6H = C_6H_5.NH_2 + 2H_2O.$$

In the commercial manufacture of aniline the nascent hydrogen is generated by the action of hydrochloric acid upon scrapings from soft iron castings. It may be noted as an interesting fact that lathe chips or borings from wrought iron or from hard castings do not answer the purpose satisfactorily. Pure aniline is a colorless liquid, freezing at 18° F., and boiling at about 363°. Its specific gravity is about 1.024 at ordinary temperatures. It unites with many other substances to form compounds, and is expelled from its salts by potash, soda, and lime. Aniline does not mix with water, but can dissolve about five per cent of its own bulk of water. See ROSANILINE.

An'iline Poisoning. The use of the anilines, and particularly of the new synthetic drugs derived from this product, has become so universal that many instances of poisoning, both acute and chronic, are observed. In acute aniline poisoning the chief effects are on the blood. It prevents the oxidation of hæmoglobin in the red blood-cells, forms methemoglobin, causes the destruction of red blood-cells (hæmolysis), and thus results in death. The chief symptoms are headache, vertigo, weakness, and stumbling walk, blue color of defective blood oxidation (cyanosis), disturbances of respiration, increase of urine, which is frequently colored reddish to dark brown from the broken-down blood-cells, depression of temperature, chills, dilated pupils, and death from asphyxia. In non-fatal cases recovery may be much protracted. Treatment consists in withdrawal of all of the poison, washing the stomach, fresh air, artificial respiration, and infusion of normal salt solution. The aniline derivations mostly used are acetanilid (antifebrin), phenacetin, exalgen, lactophenin, methacetin, malakin, phenocoll, citrophen, apolysin, cosaprin, malarin, etc. Chronic aniline poisoning, found chiefly among workers in color factories, is of much the same character, but the symptoms develop slowly. There are skin symptoms, urinary changes, and various nervous attacks, with headache, tremors, changes in sensation, anesthesiæ, etc. The treatment should involve the ventilation of the factories, thus getting rid of the color-dust floating in the moisture of the rooms.

An'imal, the word animal being derived from *anima*, breath, soul, suggests the distinction popularly accorded to animals as contrasted with plants. Linné said that plants grow and live, but that animals grow, live, and feel. As will be seen below, however, animals do not fundamentally and in their simplest forms differ from the simplest plants, as both are constituted of protoplasm, which is equally contractile in both kingdoms, and thus we now recognize the fact that nature is divided into the inorganic world and the organic, and we are coming more and more to speak of living beings as organisms, since plants and animals have so much in common. All organized beings agree in being formed of protoplasm, "the physical basis of life."

Differences between Plants and Animals.— It is difficult, when we consider the simplest forms of either kingdom, to define what an animal is as distinguished from a plant, for it is impossible to draw hard and fast lines between them. In defining the limits between the animal and vegetable kingdoms our ordinary conceptions of what a plant or an animal is will be of little use in dealing with the lowest forms of either kingdom. A horse, fish, or worm differs from an elm-tree, a lily, or a fern in having organs of sight, of hearing, of smell, of locomotion, and special organs of digestion, circulation, and respiration, but these plants also take in and absorb food, have a circulation of sap, respire through their leaves, and some plants are mechanically sensitive, while others are endowed with motion,— certain low plants, such as diatoms, etc., having this power. In plants the assimilation of food goes on all over the organism, the transfer of the sap is not confined to any one portion or set of organs as such. It is always easy to distinguish one of the higher plants from one of the higher animals. But when we descend to animals like the sea-anemones and coral-polyps, called by Wotton zoophytes, from their general resemblance to flowers, so striking is the external similarity between the two kinds of organisms that the early observers regarded them as "animal flowers;" and in consequence of the confused notions originally held in regard to them the term zoophytes has been perpetuated in works of systematic zoology. Even at the present day the compound hydroids, such as the *Sertularia*, are gathered and pressed as sea-mosses by many persons who are unobservant of their peculiarities and unaware of the complicated anatomy of the little animals filling the different leaf-like cells. Sponges until a very late day were regarded by our leading zoologists as plants. The most accomplished naturalists, however, find it impossible to separate by any definite lines the lowest animals and plants. So-called plants, as *Bacterium* or *Bacillus* and their allies, and so-called animals, as *Protamœba*, or certain monads, which are simple specks of protoplasm without genuine organs, may be referred to either kingdom. Indeed, a number of naturalists, notably Haeckel, relegate to a neutral kingdom (the *Protista*, q.v.), certain lowest plants and animals. Even the germs (zoospores) of monads like *Uvella* and those of other flagellate infusoria may be mistaken for the spores of plants; indeed, the active flagellated spores of plants were described as infusoria by Ehrenberg; and there are certain so-called flagellate infusoria so much like low plants (such as the red-snow or *Protococcus*), and the slime molds (*Myxomycetes*) in the form, deportment, mode of reproduction, and appearance of the spores, that even now it is possible that certain organisms placed among them are plants. It is only by a study of the connecting links between these lowest organisms, leading up to what are undoubted animals or plants, that we are enabled to refer these beings to their proper kingdom.

As a rule, plants have no special organs of digestion or circulation and nothing approaching to a nervous system. They differ from animals in their metabolic processes. Most plants absorb inorganic food, such as carbonic

acid gas, water, nitrate of ammonia, and some phosphates, silica, etc.; all of these substances being taken up in minute quantities. Low fungi live on dead animal matter and promote the process of putrefaction and decay, but the food of these organisms is inorganic particles. The slime molds, however, envelop the plant or low animals much as an amœba throws itself around some living plant and absorbs its protoplasm; but *Myxomycetes,* in their manner of taking food, are an exception to other molds and are now regarded as animals. The lowest animals swallow other living animals whole or in pieces; certain forms, like *Amœba* (q.v.), bore into minute algæ and absorb their protoplasm; others engulf silicious-shelled plants (diatoms), absorbing their protoplasm. No animal swallows silica, lime, ammonia, or any of the phosphates as food. On the other hand, plants manufacture or produce from inorganic matter starch, sugar, and nitrogenous substances which constitute the food of animals. During assimilation plants absorb carbonic acid and in sunlight exhale oxygen; during growth and work they, like animals, consume oxygen and exhale carbonic acid.

Animals move and have special organs of locomotion: few plants move, though some climb, and minute forms have thread-like processes or vibratile lashes (*cilia*) resembling the flagella of monads, and flowers open and shut; but these motions of the higher plants are purely mechanical and are not performed by special organs controlled by nerves. The mode of reproduction of plants and animals, however, is fundamentally identical, and in this respect the two kingdoms unite more closely than in any other. Plants also, like animals, are formed of cells, the latter in the higher forms combined into tissues.

Physiological Distinctions and Resemblances. —As has been said, the bodies of the lowest plants and animals are plainly enough made up of protoplasm. The irritability, contractibility, and metabolism of a plant-cell or a living, free unicellular plant do not differ from those of a unicellular animal (*Protozoon*) of the same morphological grade. The movements of the lowest algæ, the sensitiveness of the leaves of the mimosa-tree, of the sun-dew and other insectivorous plants, are due to the same primary cause as the movements of animals of all grades, as the power of lifting one's arm is fundamentally due to the contractibility of the protoplasm forming the cells of the muscles.

Also, as has been said, the differences in metabolism are not fundamental, those molds which do not contain chlorophyll, and bacteria, performing the same metabolic functions as regards carbon dioxid as animals. Also the power of forming cellulose in plants is not peculiar to them, as this substance is found in several types of animals, as rhizopods and *Tunicata.* Animals are also subject to the same general tropisms as plants; they are geotropic, heliotropic, thermotropic, hydrotropic, chemotropic, etc. (See TROPISMS.) To a much greater extent than formerly supposed even insects so highly developed as ants are subject to the influences of the primary factors of growth, morphogenesis, and of the conduct of life, and the instincts of animals in general are more dependent on these agents, on external stimuli, than was previously thought to be the case.

Plants Fixed Organisms; Animals as a Rule Free-moving.— While the lowest plants (*Protophytes*) are, as entire organisms, often motile, free-swimming, closely resembling monads, the higher or more specialized forms, comprising the great majority of the vegetable world, are fixed, and have always remained so. It is this fixed condition of life which, so to speak, has held the plant world in an iron grasp and kept it within its natural limits. On the other hand animals as a rule are active, free to move, restless. Whenever animals, though born as free-swimming germs or larvæ, are constrained by change of circumstances to become attached or fixed to the sea-bottom or solid objects, they degenerate and become more and more subject to the influence during growth of those cosmic and physical forces, such as gravity, light, air, currents of water, etc., which determine the shapes and morphology of plants. Fixed animals, like the zoophytes or the polyps, sea-anemones, all sponges, cœlenterates, *Polyzoa,* etc., which lead a purely vegetable life, tend to assume plant-like shapes. Even the echinoderms, as the fixed crinoids, are plant-like, hence their name, sea-lilies. It is freedom of motion, greater activity, which led to the vastly more complex and higher types of life in animals, to the development of a nervous system, and to the origin of mind and intelligence.

Plants Not the Primitive Basis of Animal Life.— As the lowest plants and animals are scarcely distinguishable, it is probable that plants and animals first appeared contemporaneously; and while plants are generally said to form the basis of animal life, this is only partially true; a large number of fungi are dependent on decaying animal matter; and most of the *Protozoa* live on animal food, as do a large proportion of the higher animals. The two kingdoms supplement each other, are mutually dependent, and probably appeared simultaneously in the beginning of things. It should be observed, however, that the animal kingdom greatly overtops the vegetable kingdom, culminating in man.

The Animal Series Tree-like.— It was an old idea that the living world forms a regular or linear series, more or less regularly graduated. The older naturalists spoke of "the scale of being," "the chain of being." Lamarck was the first to show that such a series does not exist. He compared the animal kingdom to a tree, "a branching series, irregularly graduated," and he recognized that there were breaks, missing branches "owing to the extinction of some species." He explains that the animal kingdom begins by at least two special branches, then ending in branchlets. He thus broke entirely away from the idea of a continuous ascending series imagined by Bonnet and others in the 18th century. While therefore there is, speaking in general terms, a progressive series of animal forms from monad to man, the animal kingdom more truly resembles a tree which began to send out branches very near its base; many of the branches being inextricably interlaced, while others — representing the degenerate types, as sponges, stationary or fixed groups, such as polyps, barnacles, many parasites, etc.— are

downward-bent branches. As a whole, however, the branches show a tendency to ascend and spread out more or less upward. See ZOOLOGY.

An'imal Al'kaloids. Ptomains (q.v.) was the name originally given to a large class of products resulting from the putrefactive process occurring in animal substances. These possessed many of the chemical reactions of the vegetable alkaloids and have been termed animal alkaloids. Similar products formed in the human body, as the result of normal metabolism chiefly of lecithin, or proteids, are termed leucomains. Many of these ptomains and leucomains are highly poisonous toxins. See ALKALOIDS; METABOLISM; PTOMAINS; TOXICOLOGY.

Animal Charcoal. See CHARCOAL.

An'imal Chem'istry, the department of organic chemistry which investigates the composition of the fluids and the solids of animals, and the chemical action that takes place in animal bodies. There are four elements, sometimes distinctively named organic elements, which are invariably found in living bodies, namely, carbon, hydrogen, oxygen, and nitrogen. To these may be added, as frequent constituents of the human body, sulphur, phosphorus, lime, sodium, potassium, chlorin, and iron. The four organic elements are found in all the fluids and solids of the body. Sulphur occurs in blood and in many of the secretions. Phosphorus is also common, being found in nerves, in the teeth, and in fluids. Chlorin occurs almost universally throughout the body; lime is found in bone, in the teeth, and in the secretions; iron occurs in the blood, in urine, and in bile; and sodium, like chlorin, is of almost universal occurrence. Potassium occurs in muscles, in nerves, and in the blood corpuscles. Minute quantities of copper, silicon, manganese, lead, and lithium are also found in the human body. The compounds formed in the human organisms are divisible into the organic and inorganic. The most frequent of the latter is water, of which two thirds (by weight) of the body are composed. The organic compounds may, like the foods from which they are formed, be divided into the nitrogenous and non-nitrogenous. Of the former the chief are albumen (found in blood, lymph, and chyle), casein (found in milk), myosin (in muscle), gelatin (obtained from bone), and others. The non-nitrogenous compounds are represented by organic acids, such as formic, acetic, butyric, stearic, etc.; by animal starches, sugars; by fats and oils, as stearin and olein, and by alcohols (two compounds, cholesterin and glycerin).

An'imal Col'ors. See COCHINEAL; KERMES; PURPLE SHELLS.

An'imal E'lectric'ity, electricity which certain species of animals, particularly those inhabiting the water, have the power of producing. The amount which they can produce varies with different animals. The electric eel or torpedo can give a severe shock. Contact between the nerve and muscle of a frog will produce a feeble current of electricity.

An'imal Flow'er, a term applied to sea anemones or similar polyps on account of the resemblance which their expanded tentacles bear to flower petals.

An'imal Heat, nearly all animals possess a heat-regulating mechanism by which they maintain a temperature necessary for the continuance of life processes. In many cold-blooded animals this sustains a temperature only slightly above that of the surrounding media, and thus in winter they relapse into a torpid state. Some few, however,— bees being an example,— have a higher temperature and are not torpid. In warm-blooded animals, especially those high in the evolutionary scale, a high constant temperature is usually sustained. Some warm-blooded animals occupy an intermediary position. In summer the temperature is high and constant, in winter they hibernate, and the temperature is low and dependent upon that of the surrounding medium. Some cold-blooded animals living in the tropics may really show very high degrees of temperature, thus the terms warm-blooded and cold-blooded are relative only. The mean average temperature in man is 36.97° C. (98.4° F.) in the mouth, 36.98° C. (98.5° F.) in the axilla, and 37.2° C. (99° F.) in the rectum. There are slight daily variations, the lowest temperature usually being between midnight and early morning during sleep. Certain warm-blooded animals show interesting average temperatures. Thus, the horse is 99–100° F., ox 100–101° F., cow 101–102° F., sheep 104–105° F., dog 100–101° F., cat 101° F., pig 101–103° F., rabbit 101–107° F., rhesus monkey 101° F., duckbill platypus 76° F., hen 106–109° F., duck 107–110° F., sparrow 110° F. In cold-blooded animals the temperature, as has been noted, varies widely. The study of the temperature of bees is of much interest in this connection.

Several conditions modify the regulation of the animal heat: day and night, age, muscular work, sleep, sex, race, pregnancy, idiosyncrasies, surrounding temperature, season of the year, baths, and certain drugs, all have a distinct influence on the heat regulatory apparatus. The variations in temperature in man compatible with life are wide; a range of less than 2° F. is normal, but variations from 75° to 112° F. have been recorded and the patients recovered. Temperatures below 80° F. and above 106° F. are dangerous.

The chief sources of animal heat are the chemical processes of the body and they are dependent on the food supply. Every kind of food has its definite percentage of heat-producing elements measured in units, or calories. Thus 1 gm. (15 grains) of the white of egg has 4,896 calories; the same amount of cow's milk 5,733 calories, of fat 9,600 calories, etc. These are purely physical values, but they have their physiological equivalents. The chief sources of heat production in the human body are the muscles, the heart contraction being a very important one, and the glands (intestines, liver, etc.). Loss of heat takes place through the skin by radiation and conduction, by evaporation, from the respiration, and from the dejecta.

Regulation of these many factors is in the province of the nervous system. The vasomotor system controls the heat loss by regulating the amount of blood in the deep and superficial portions of the body, the respiratory centre regulates the amount of respiration, and the cerebral cortex regulates the amount of muscular activity that is the main source of the heat production. See FEVER.

An'imal Mag'netism, a science or art, so called because it was once believed that it taught the method of producing on persons of susceptible organization effects somewhat similar to those which a magnet exerts upon iron. Paracelsus (b. 1493) maintained that the human body was endowed with a double magnetism; on the one side attracting to itself the planets, whence comes wisdom and the senses, on the other side attracting the elements and nourished by their disintegration; that the attractive virtue resembles that of the magnet, and that healthy persons attract the enfeebled magnetism of the sick. Many writers of the 16th century sought to explain all natural phenomena by this principle.

Mesmer (b. 1734) drew largely from these sources in preparing his thesis on 'The Influence of the Planets in the Cure of Diseases.' Believing in a subtle fluid through which the heavenly bodies acted upon living beings, he called this animal magnetism, because of certain properties he believed it to possess in common with the magnet. The sick were said to have been cured by the influence of magnets manipulated by the Jesuit Father Hell, in 1774, in Vienna. Mesmer began the use of the magnet, but soon gave it up, restricting himself to passes of the hand over or near the body of the patient, or to placing the hand in contact with the body in the hypochondriac region, or the lower part of the abdomen. He declared animal magnetism to be distinct from the magnet. His doctrine obtained notice for a time. As the patients increased in number it became impossible for him to treat each one separately, and he devised a trough about which 30 persons or more could be magnetized at once. This *baquet* or trough consisted of a circular oaken case about one foot deep, surrounded by curtains through which a subdued light was permitted to penetrate. In the bottom of the case was a layer of powdered glass and iron filings; on this lay bottles arranged with their necks all pointing toward the centre; a second lot of bottles were arranged with their necks in the opposite direction: the trough might be filled with water or remain dry. Through the lid of the trough jointed iron rods projected and branched in various directions: these were held by the patients. Should the numbers be very large a second row of patients might be connected with the first row by cords about their bodies; and a third row could be arranged by joining hands with the second row. During an interval of silence a melodious air was heard from an adjoining room. Soon, influenced by the magnetic effluvia issuing from the *baquet*, curious phenomena were produced. Some of the persons under treatment seemed to experience no change in their condition; others coughed, experienced pain, and sweat; others suffered from convulsions of greater or less violence which lasted for hours. These convulsions were preceded or followed by a state of languor and depression. Such a state of convulsions, when produced in one person, was quickly followed by similar conditions in others. The movements of the limbs and body, the twitchings of the hypochondriac and epigastric regions are manifest signs of hysteria and may be referred to the nervous antecedents of the group of persons and to the influence of imitation and suggestion. Mesmer, in a coat of lilac silk, walked around among the crowd, touching the diseased parts of the bodies of the patients with a long iron rod which he carried in his hand.

His cures in Paris attracted so much attention that in 1784 a commission was appointed by the government to examine into the matter. The commission consisted of members of the Faculty of Medicine and of the Academy of Sciences.

A second commission from the Royal Society of Medicine was charged to make a distinct report on the same subject. Mesmer and his assistants desired that the cures that had been effected be accepted as proof of the existence of animal magnetism. The commissioners, however, placed themselves under treatment once a week; they experienced no convulsive movements or other effects that appeared to be shown in some patients. They found that patients unaware of the fact that they were being magnetized experienced none of its effects, and that patients who were told they were being magnetized experienced the symptoms, though the magnetizer was not near them.

The conclusion of the report of the commissioners is as follows: "The commissioners have ascertained that the animal magnetic fluid is not perceptible by any of the senses; that it has no action, either on themselves or on the patients subjected to it. . . . Finally, they have demonstrated by decisive experiments that imagination apart from magnetism produces convulsions, and that magnetism without imagination produces nothing. They have come to the unanimous conclusion with respect to the existence and utility of magnetism that there is nothing to prove the existence of the animal magnetic fluid; that this fluid, since it is non-existent, has no beneficial effect; that the violent effects observed in patients under public treatment are due to contact, to the excitement of the imagination, and to the mechanical imitation which involuntarily impels us to repeat that which strikes our senses."

The existence of a magnetic fluid is yet to be proved. All of the phenomena which Mesmer produced and attempted to explain by the existence of such a fluid are now explained by the principle of hypnotic suggestion. See HYPNOTISM. Consult Binet and Fere, 'Animal Magnetism' (1888); Albert Moll, 'Hypnotism' (1898).

An'imal Psychol'ogy is the science which investigates the phenomena of the life of animals lower than man with reference to their mental endowment. It seeks to know the animal mind, its nature and functions, in the different orders of animal life. In ordinary use the term is synonymous with comparative psychology,— a term expressing the fact of the necessary starting-point of the science from the human mind, of which alone we have direct knowledge. This term, however, may be applied to any department of psychology whose method is comparative — for example, folk psychology, the study of the mental life of different races of men — and the more definite name, animal psychology, is therefore to be preferred. The interest of the science is threefold: in itself it grants insight into animal nature and life; in relation to man it lends light to anthropology and psychology, especially with reference to human instincts and impulses; and it has a deep

bearing upon the problems of evolution, both biological and mental. With regard to these latter two interests, it is a branch of genetic psychology (q.v.), treating, together with folk psychology, the phylogenetic as distinct from the autogenetic problem; that is, the question of mental evolution as distinct from mental development of the individual.

Animal psychology, as a science, dates from the middle of the last century, finding its rise in the movement of thought inaugurated by Charles Darwin. The first suggestion, however, of a genetic psychology was made by Aristotle (385–322 B.C.), who laid the foundation for so much of modern thought. The organic world, he said, forms an ascending scale, all of whose numbers are differentiated from inorganic bodies by an inner impelling principle, a "psyche" or soul, which employs a number of organs to realize its purposes. The soul of the plant performs the functions of assimilation and reproduction only; that of the animal has besides the faculty of feeling, and, in the higher orders, memory. The soul of man, in addition to all these, possesses the faculty of knowledge or reason, and is the end or goal of the process of nature's ascent. Despite this profound hint of the father of logic and psychology, almost the only reference to the animal mind for many centuries is in form of very doubtful anecdotes of individual cases of animal sagacity. Pliny tells the story of an elephant that was punished during a performance for his bad dancing, and set to work in the night to practise, so that he could do it better the next time — a good example of a familiar type. Descartes (1596–1650) looked upon the body as a mere automaton, to which mind or soul is essentially opposed in nature — man, however, being a combination of the two. But the animal does not possess mind and is thus merely an unconscious machine. The logical outcome of this doctrine is that animals cannot even feel pain; for sensations, he says, belong to the body, but the soul alone can be conscious of them. It is somewhat doubtful whether Descartes himself was not inconsistent here, and admitted that animals could feel while denying them the cognitive aspect of sensations. His followers, however, notably Bossuet and Malebranche, held that sensations in the animal are nothing more than mechanical, unfelt movements, and used the argument to justify vivisection. Pascal welcomed the doctrine because it relieved the divine goodness of the charge of animal suffering. The most interesting application of the view, however, is that of La Mettrie (1709–51), one of Darwin's precursors in holding a theory of evolution. If the animal is a machine, he said, man is just as much a machine, and his so-called soul or mind is merely a higher development of the material animal functions. The animal is thus made the measure of man, a false animal psychology the basis of a false human psychology.

But the modern theory of evolution, noted in the work of Darwin, took precisely the opposite standpoint. Man is not a machine, but possesses mind; the animals, too, must then possess mind of some sort or degree. Physically man is related to the lower animals through a long process of evolution: we should expect, then, a mental evolution co-ordinate with this biological evolution. This conviction gave birth to animal psychology, first undertaken, in support of a theory which had to win its way, by Darwin himself, Romanes and Lindsay as pioneers. Their works are marked by industrious observation and collection of facts; but the first flush of a theory prevented the most sober elimination, collation, and interpretation. Now, relieved from the burden of proof first cast upon it, animal psychology is being investigated with an increasing degree of scientific accuracy and careful experimental method.

There must, of course, always be one fundamental difference between the methods of human and animal psychology. The former is always, in the last analysis, introspective; the latter never can be. We are conscious of our own minds; but that of the animal is forever outside of such direct knowledge. The animal psychologist, therefore, can only study phenomena, the objective manifestations of the animal's mental life; and from these he must infer what that inner life is. In this fact lie the fundamental difficulty of the science and its most fruitful source of error. The observer may of course underestimate the animal mind — a mistake hardly probable now. The great danger lies rather in overestimation. The "psychologist's fallacy" of importing into other minds the processes of his own is here possible as nowhere else. We know no mind save that of man: there can be no thought or discussion of mental processes except from this basis. Through lack of language the animal can tell us nothing of its mind — we must infer; and even the most careful psychologist is liable to read into the facts too high an interpretation. This danger is often increased by an inclination to see things in the best light and to observe facts as interesting as possible; or by a false ideal of generosity to the animal, denying man the "conceit" of usurping the highest faculties. Special care must be observed in regard to the animal anecdote, liable to be colored by imagination or to be ill-authenticated; and it must be remembered that such stories relate in general to pets, individual cases of specially gifted animals living in a human environment. Thorndike well says: "Most of the books do not give us a psychology, but rather a eulogy, of animals. . . . Anecdotes give really the abnormal or super-normal psychology of animals." All these latter dangers may be avoided; but the "psychologist's fallacy" of unintentionally humanizing the animal is an inevitable difficulty which must always be reckoned with. Wundt cites and comments upon one of the stories about ants from Romanes' 'Animal Intelligence,' which is full of instances of the various fallacies mentioned: "A friend of the ants gives this account: At one formicary half a dozen or more young queens were out at the same time. They would climb up a large pebble near the gate, face the wind, and assume a rampant posture. Several having ascended the stone at one time, there ensued a little playful passage-at-arms as to position. They nipped each other gently with their mandibles and chased one another from favorite spots. They, however, never nipped the workers. These latter evidently kept a watch upon the sportive princesses, occasionally saluted them with their antennæ in the usual way, or touched them upon the abdomen, but apparently allowed them full liberty of action. . . . Why should not a number of young queens have been crowded together upon a pebble, and some workers have been

with them, and occasionally touched them with their antennæ, as ants do everywhere? But that they 'sported' and played, that the others 'kept a watch upon them' like chaperones, and now and then did homage to them by 'saluting' — that is all due to the imagination of the observer. He would hardly have told the story as it stands had not zoology introduced the misleadingly suggestive term 'queens' for the mature female insects. If the adults are 'queens,' the young females must, of course, be 'princesses,' and since no princess ever went out without an attendant or chaperone, the rest of the narrative follows as a matter of course." Even the most sober observation may err if there be no variation of circumstances by experiment. Huber found that an ant, if taken from the nest and returned after four months, was received in a friendly way by its former companions, while ants from a different nest, though of the same species, were driven away. This was considered evidence of the accuracy of memory in these insects. But Lubbock found that ant larvæ taken from the nest and not returned until they were fully developed were received with the same cordiality; and Bethe, that a strange ant was so "recognized" if it had been previously dipped into an impounded mess of the home ants. This recognition was thus seen to be merely a chemo-reflex, perhaps through a specific odor.

The only sound basal principle for a true animal psychology is that laid down by Lloyd Morgan: "In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty if it can be interpreted as the outcome of the exercise of one which stands lower in the psychological scale." Wundt points out that this is nothing other than the well-known law of economy which is so fundamental in physical science; and that animal psychology, by often refusing the simplest explanation, has thus adopted an implicit principle exactly opposite to that of all other exact science. Groos points out an important truth in relation to this law of economy, and indicates the trend of present scientific method in animal psychology, when he says: "If the observation of animals is to be rendered fruitful for the unsolved problems of anthropology . . . attention must be directed less to particular resemblances to man and more to specific animal characteristics." This does not mean that the observer of animals need not be a psychologist in the proper sense; for lack of training in human psychology has been a fruitful source of error in the investigation of the animal mind. Mental facts cannot be interpreted at all by one who does not know the laws and processes of the human mind, since it is the only mind we know. No more can the animal psychologist dispense with training in biology. "It is necessary," says Morgan, "that accurate observation and a sound knowledge of the biological relationships of animals should go hand in hand with a thorough appreciation of the methods and results of modern psychology." "The animal psychologist," says Groos, "must harbor in his breast not only two souls, but more; he must unite with a thorough training in physiology, psychology, and biology, the experience of a traveler, the practical knowledge of the director of a zoological garden, and the outdoor lore of a forester."

Exact experimental methods are gradually taking the place of the animal anecdote and the more loose general observation. Laboratory study of animals, where conditions can be standardized and environment controlled, even at the risk of some degree of artificiality, is leading to surer results than were ever possible through former haphazard methods. Of course such investigation is most practicable in the cases of the micro-organisms whose investigation would be otherwise impossible. Careful study of these under the microscope has yielded data pointing to the presence of mind far down in the scale of life, as evolution would lead us to expect. Says Binet: "If the existence of psychological phenomena in lower organisms is denied, it will be necessary to assume that these phenomena can be superadded in the course of evolution in proportion as an organism grows more perfect and complex. Nothing could be more inconsistent with the teachings of general physiology, which shows us that all vital phenomena are already present in undifferentiated cells." Jennings thinks that the poramecium, one of the *Protozoa*, is the lowest in the scale, its actions being explicable by "simple irritability, or the property of responding to a stimulus by a fixed set of movements."

With regard to methods of experiment upon the larger animals, such as dogs and cats, Thorndike's investigations may be cited. He placed a number of animals in cages and studied their actions when under the powerful motive of hunger. His results have tended to lessen, rather than increase, opinion as to the high character of the intelligence of these animals. His work, he says, "has rejected reason, comparison or inference, perception of similarity, and imitation. It has denied the existence in animal consciousness of any important stock of free ideas or impulses, and so has denied that animal association is homologous with the association of human psychology." Mills strongly opposes this method, and inclines toward the explanation of animal action by the higher mental powers. Groos has made a most important contribution to the science by pointing out the psychological and biological significance of animal play.

In general, Aristotle's statement of the chasm between man and the lower animals still stands. There is not sufficient evidence to declare animals rational. The primary acts of the animal mind are cognition and recognition, which involve the associative faculties; and there have been observed no activities which would be sufficient ground for attributing to the animals the higher powers of conception and reasoning. Emotions they certainly do possess; they manifest an æsthetic sense. Yet there is no proof of æsthetic judgment in relation to an ideal; the powers of imagination and thought are essentially human. Even in their play, says Wundt, there is no inventiveness, no imaginative activity. Neither is it necessary to postulate on animal conscience for explanation of the facts which seem to point toward such an ethical sense. Most of the problems of the animal mind and of its varying degrees in different orders centre in the theory of instinct (q.v.).

As animal psychology had its real birth in the theory of evolution, it is in connection with this that its greatest importance lies. Most of its problems are common to biology and psychol-

ogy. All of its questions have a deep bearing upon biological evolution which, it is now seen, must take account of the mental processes at different stages in the life-forms if it is to be at all adequate; just as mental evolution, on the other hand, must recognize the influence of the evolution of the physical organism. The future theory of evolution will be psycho-physical. This mental factor in biological evolution is already seen in the theories of sexual selection, of mimicry, and of organic selection.

Bibliography.—The best introduction to the subject, eminently sane and modern, is C. Lloyd Morgan's 'Introduction to Comparative Psychology' (Lond. 1894); Wundt, 'Human and Animal Psychology' (trans. 1896); Groos, 'The Play of Animals' (trans. 1898); The Play of Man' (trans. 1901); Morgan, Animal Life and Intelligence' (1891); 'Habit and Instinct' (1896); Morgan, 'Animal Behavior' (1900); Thorndike, 'Animal Intelligence' (1898); Darwin, 'The Origin of Species' (Lond. 1859, N. Y. 1901); 'The Descent of Man' (Lond. 1871, N. Y. 1901); Romanes, 'Mental Evolution in Animals' (1883); 'Animal Intelligence' (1883); Binet, 'Psychic Life of Micro-organisms' (1894); Lubbock, 'Ants, Bees, and Wasps' (1882).

An'imal Sym'bolism in Ecclesiastical Architecture, a work by E. P. Evans; a work designed to trace the wide use of animal symbols in religious relations. The story of this symbolism in its application, with modifications, in architecture, is told with fullness of knowledge and sound judgment of significance of facts.

An'imal Wor'ship, a practice found to prevail or to have prevailed in the most widely distant parts of the world: in India, where it is a consequence of the belief in the transmigration of souls, according to which the soul of a god may pass into the body of an animal; in the heart of Africa, where it is still in life; in South America, where very remarkable instances of it were met with by the earliest Spanish visitors; but its most extraordinary developments were in ancient Egypt. Nearly all the more important animals found in the country were regarded as sacred in some part of Egypt. Some animals were held sacred throughout the whole land, but in many cases the animals enjoyed a local reverence only, an animal that was worshipped in one nome might be an object of aversion in the next and destroyed at every opportunity. The degree of reverence paid to the sacred animals was such that the voluntary killing of one was punishable with death, and if any one killed an animal involuntarily in a nome in which it was held sacred he was punished by a fine. Throughout Egypt the killing of a hawk or an ibis, whether voluntary or not, was punished with death. So strong was the feeling of the people on this point that when it was of the utmost importance to the Egyptians that they should conciliate the Romans, even the intercession of the king was impotent to save from the fury of the people a Roman soldier who had killed a cat. The animals were regarded as sacred to the deities, and the worship paid to them was symbolical. The Egyptian idols always bore on a human body the head of the animal sacred to the god represented by the idol. Only in three cases were certain animals believed to be incarnations of the deities themselves. These were at Memphis, where the bull Apis was worshipped as an incarnation of Phtha; at Heliopolis, where the bull Mnevis was reverenced as an incarnation of Osiris; and at Mendes, where a goat received worship as an incarnation of Khem.

An'imal'cule, the diminutive of animal; an old name applied to animals of microscopic size, and now frequently used for many *Protozoa*, such as the *Amœba* and various *Infusoria*. The term is not now used in zoology in any strict significance, nor employed in classification.

An'imals, Cruelty to. The earliest laws for the prevention of cruelty to animals were passed in England, whence the movement spread to the Continent and the United States. The first society for the prevention of cruelty to animals in the United States was chartered in 1866; and the agitation by similar societies has resulted in laws in almost every State providing for the punishment of cruelty to domestic animals by fines from $5 to $100, imprisonment from 30 to 60 days, or both. These societies work also to prevent cruelty by education, advice, and personal effort in enforcing the law.

An'ima Mun'di, ăn'ĭ-mȧ mŭn'dĭ ("soul of the world"), an ethereal essence considered by ancient philosophers as the informing principle of the universe of matter and bearing the same relation to it that the human mind does to the body. The conception originated in the East and was held by the Egyptians. Anaxagoras (q.v.), one of its earliest Western exponents, believed that it gave form to the universe; Plato treats of it at large in his 'Timæus'; Aristotle considered the world a living entity, but informed by an external spirit. Nearly all philosophical sects dallied with the idea. The Stoics thought it the sole vital principle of the universe, but not the universe itself in a different shape, as the doctrine of pantheism imputed to them would imply. In modern times it appears in the works of Cornelius Agrippa (who calls it *spiritus mundi*), Paracelsus, Van Helmont, Giordano Bruno, Sebastian Franck, Jacob Boehme, etc., in More and Cudworth, in the later Platonists, and in the philosophy of Schelling, who has incorporated it into his whole system.

Anime, ȧ-nẹ-mạ, a resin supposed to be obtained from the trunk of an American tree (*Hymenœa courbaril*). It is of a transparent amber color, has a light, agreeable smell, and is soluble in alcohol. It strongly resembles copal, and, like it, is used in making varnishes. Specific gravity is 1.028 to 1.054.

An'imism, the system of philosophy propounded by Stahl, and based on the idea that the soul (*anima*) is the seat of life. In modern usage a term applied to express the general doctrine of souls and other spiritual beings, and especially to the tendency, common among savage races, to explain all the phenomena in nature not due to obvious natural causes by attributing them to spiritual agency. Among the beliefs most characteristic of animism is that of a human apparitional soul, bearing the form and appearance of the body, and living after death a sort of semi-human life.

Anio, ä'nẹ-ō, **Aniene,** or **Teverone,** an Italian river tributary to the Tiber, which it enters from the east a short distance above Rome.

Ankerite, a carbonate belonging to the calcite group of minerals. It is intermediate between calcite, magnesite and siderite, the normal mineral being a carbonate of calcium, magnesium and iron, having the formula $2CaCO_3.MgCO_3.FeCO_3$. It occurs in rhombohedral crystals which have perfect rhombohedral cleavage, a hardness of 3.5 to 4, specific gravity of about 3, vitreous to pearly lustre, and usually white color. It also occurs in granular, crystalline and compact masses.

An'nals of a Sportsman, a work by Ivan Turgeneff, consists of 22 short sketches of Russian peasant life, appearing in book form in 1852 and establishing the author's reputation as a writer of realistic fiction. Turgeneff represents himself as on a hunting trip through the country districts, noting the local life and social conditions, and giving truthful studies of the state of the serfs before their liberation by Alexander II.; his book being one of the agencies that brought about that reform.

Annam, ăn'näm'. See ANAM.

Annamaboe, ä'nä-mä-bō', a seaport town, with a fort, on the Gold Coast, in western Africa, 10 miles east of Cape Coast Castle. It was at one time a principal mart for slaves, in trafficking in which many of its inhabitants became wealthy, and is still a place of considerable trade. Pop. about 5,000.

An'nan, a Scottish seaport and parliamentary borough in Dumfriesshire, on the Annan River. It has railroad connection with Glasgow, Carlisle, and Edinburgh, and water connection with Liverpool and Whitehaven. The important manufactures are tanning, rope-weaving, and cotton-spinning. Pop. (1901) 5,804.

Annan, a river of Scotland, having a course of about 50 miles, flowing from north to south through the centre of Dumfriesshire to the Solway Firth, its sources being not far from those of the Tweed and Clyde.

Annap'olis, Md., the capital and port of entry of Maryland and county-seat of Anne Arundel County; on the Severn River, near Chesapeake Bay and several railroads; 40 miles east of Washington, D. C. It is in a fruit and berry-growing region; has oyster-packing plants, marine railway, glass factory, a national bank, daily, weekly and other periodicals, and a property valuation of $3,000,000; is widely known as the seat of the United States Naval Academy, and contains also St. John's College, several State buildings, a convent, a house of Redemptorist Fathers, residences of many naval officers, and bronze statues of Gen. John de Kalb and Chief-Justice Roger B. Taney. The city was founded in 1649 and was first named Providence. It received a city charter and its present name, in honor of Queen Anne, in 1708. The first Federal Constitutional Convention was held here in 1786, and Washington surrendered his commission in the Senate-room of tne State House. Pop. (1900) 8,525. (Powell, 'Historic Towns of the Southern States,' 1900.)

Annapolis, a town in Nova Scotia, the capital of Annapolis County, and up to 1750 of the whole peninsula, situated on an arm of the Bay of Fundy, at the mouth of a river also called Annapolis, 95 miles west of Halifax. The place was originally called Port Royal, and is one of the oldest European settlements on the American continent. Pop. (1901) 1,019.

Annap'olis Convention. This small gathering was held 11 Sept. 1786, to discuss proposed changes in the Articles of Confederation. By the time it met, the Confederation had utterly broken down: Congress could not find means to carry on the government, and the Annapolis Convention was anxiously looked to as the last hope by the business interests. Only five States were actually represented,— New York, New Jersey, Pennsylvania, Delaware, and Virginia. These, however, were precisely the ones which wished the entire Confederation remodeled. New Jersey had instructed its delegates to accept nothing but a new federal government; and the New York group, headed by Alexander Hamilton, was equally zealous for a stronger system. John Dickinson, one of the chief authors of the Articles of Confederation, was made chairman; and a committee was appointed to prepare a report, which was drafted by Hamilton, though he was not on the committee. This report recommended that the States they represented should agree, and try to induce the others to agree, "to meet at Philadelphia on the second Monday of the next May, to consider the situation of the United States and devise such further provisions as should appear necessary to render the Constitution of the Federal government adequate to the exigencies of the nation; and to report to Congress such an act as, when agreed to by them and confirmed by the legislatures of every State, should effectually provide for the same." They then adjourned; but this call led to the convention of 1787, where the Constitution was adopted.

Ann Arbor, Mich., city and county-seat of Washtenaw County, on the Huron River, and the Michigan Central; Detroit, Ypsilanti & Ann Arbor and the Ann Arbor Railroads. It is situated among the picturesque hills of Southern Michigan, 38 miles from Detroit, and is regarded as one of the most desirable residential cities in the middle West. Here is the seat of a famous school of learning, the University of Michigan. (See MICHIGAN, UNIVERSITY OF.) Ann Arbor has, among prominent buildings, a homœopathic hospital, county court house, post-office building, high school and numerous churches and public and private schools. It is the business centre of a large agricultural and fruit growing region and an important shipping point. It has extensive manufactures of agricultural implements, furniture, pumps, engines, boilers, lumber products, organs, pianos, flour, wagons, etc. The municipal government is vested in a mayor, elected every two years, and a city council. The subordinate city officials are mostly appointed by the mayor, who acts under a revised charter of 1895. The city has an extensive electric light system, water works plant and electric traction lines connecting with Jackson, Kalamazoo, Battle Creek, Detroit and other cities. It has daily and weekly newspapers and four national banks. It was originally settled in 1824 and was incorporated as a city in 1851. Pop. (1890) 9,431; (1900) 14,509; (1903) est. 17,200.

Annas, an'as (Hebrew, "merciful"), a Jewish high priest; appointed high priest by Quirinus, proconsul of Syria, about 7 A.D., and deposed

by Valerius Gratus, procurator of Judea, in 14 A.D. His family was wealthy and he was evidently very influential, as the office of high priest was held by five of his sons and his son-in-law, Caiaphas before 36 A.D. In the New Testament (Luke iii. 2, John xviii. 13, Acts iv. 6) Annas is mentioned as high priest conjointly with Caiaphas. The first hearing of Jesus was before Annas, who sent him bound to Caiaphas.

Annates, a certain portion of the year's fruits or revenues paid to the Pope and his court. The term properly denotes the sum of half a year's revenue of a vacant benefice (q.v.) payable by the new incumbent to the Pope. It was also used to indicate the tribute every bishop or mitred abbot was obliged to pay for the support of the Pope and cardinals, and the lesser sums they contributed for the support of members of the Papal household. These tributes or taxes were frequently a cause of contention between ecclesiastical and civil authorities. An effort was made to put an end to these contentions in the Councils of Pisa and Constance, and gradually all the minor tributes were abolished. In the Council of Basel it was decided to abolish every tribute of this kind, but to raise revenues for the antipope Felix exactions doubly severe were imposed on his adherents. In Germany the payment was satisfactorily regulated in the Concordat of Vienna (1448) and after several modifications it was finally abolished in 1803. In France the payment was stipulated in a Concordat between Innocent X. and Francis I.; it was finally refused entirely in 1789, and its abolition recognized in the Concordat of 1801. In England such sums were first paid to the Archbishop of Canterbury, later to the Pope, and transferred to the Crown in 1534, the sovereign at present retaining only those derived from bishoprics and Crown livings, the rest, since Queen Anne's time (see QUEEN ANNE'S BOUNTY), going to increase the poorer livings. The Pope used them to support himself, the cardinals, and other papal officials; to defray the expenses of nuncios, legates, bishops exiled from their sees, princes deprived of their thrones, envoys and vicars apostolic to missionary countries. As this source of revenue has been constantly falling off during the past century, the deficit is made up by the voluntary contributions of Catholics, known as «Peter's Pence» (q.v.). See Ferraris, 'Prompta Bibliotheca.' See FIRST FRUITS.

Anne, ăn, Queen of Great Britain and Ireland: b. at Twickenham, near London, 6 Feb. 1664; d. 20 July 1714. She was the second daughter of James II., then Duke of York, and Anne, his wife, daughter of the Earl of Clarendon, and was educated according to the principles of the English Church. In 1683 she was married to Prince George, brother to King Christian V. of Denmark. On the arrival of the Prince of Orange in 1688 Anne desired to remain with her father; but was prevailed upon by Lord Churchill, afterward Duke of Marlborough, and his wife, to join the triumphant party. After the death of William III. in 1702 she ascended the English throne. Her character was amiable but lacking in firmness, and she was influenced first by Marlborough and his wife and afterward by her favorite, Mrs. Masham. Most of the principal events of her reign are connected with the war of the Spanish Succession. The only important acquisition that England made by it was Gibraltar, captured in 1704. Another very important event of this reign was the union of England and Scotland, under the name of Great Britain, which was accomplished in 1707. She seems to have long cherished a wish to secure the succession to her brother James, but this was frustrated by the internal dissensions of the Cabinet. Grieved at the disappointment of her secret wishes, she fell into a state of weakness and lethargy and died. The reign of Anne was distinguished not only by the brilliant successes of the British arms, but also on account of the number of admirable and excellent writers who flourished at this time, among whom were Pope, Swift, and Addison. See Oldmixon, 'Life of Queen Anne' (1716); Ashton, 'Social Life in the Reign of Queen Anne' (1882).

Anne, Sister, the sister of Fatima in the tale of 'Bluebeard.' From the top of the castle tower she awaits the arrival of their brothers to rescue them.

Annealing, a process to which metals and glass are subjected in order to increase their ductility, or lessen their liability to fracture under sudden stress. It is usually effected by heating the substance to be annealed until it approaches softness, and then allowing it to cool very slowly. Copper, however, is best annealed by heating it to a high temperature and then plunging it immediately into water. Metals that are to be annealed should be heated in close vessels, so that they may not be affected by direct contact with the fuel. It is not uncommon to anneal large masses of metal or glass by allowing the fires in the heating furnace to go out, and permitting the furnace and its contents to cool together. The articles to be annealed are also often buried, while still hot, in lime, ashes, or some other poor conductor of heat, and left until cold. Metals that are to be drawn into wire, or rolled into sheets, or pressed into complicated shapes, usually require annealing during the process, as otherwise they are likely to become brittle and crack or break. Zinc, however, grows strong and flexible as it is drawn into wire, though it loses its flexibility and regains its crystalline structure if kept in boiling water for a time. It is usually taught that the object of annealing is to soften the material sufficiently to allow molecules to move slightly among themselves, and thus relieve the strains previously introduced by sudden cooling, or by the violent stresses to which the material has been subjected in the process of working. This theory is very possibly true to a certain extent, but the anomalous cases of copper and zinc, cited above, show that it can be regarded only as a first approximation to the ideal theory of annealing, which has yet to be discovered. See TEMPERING.

Annecy, ăn'sĕ', a town of eastern France, situated in the central part of the department of Haute Savoie at the northwest end of Lake Annecy. It has manufactures of silk, cotton, wool, and steel, and contains many buildings of historical interest, including a cathedral and the old castle of the counts of Genevois. Pop. (1901) 13,611.

An'nexa'tion, politically, the formal incorporation by a State with itself of territory previously under another government; usually territory contiguous to itself or its colonial possessions, or an insular neighbor, but only because other annexations are rarely desired, not from any principle of international law. The annexation may be by purchase, peaceful cession, or conquest. Existing laws and local authorities do not lose their binding force and title to obedience till the formal act of annexation is passed by the new power, or treaty or proclamation validates it, even after cession by the old; though that cession cancels all legal relation to the former sovereign power.

Annexations to the United States.— (1) The Louisiana Purchase (q.v.) from Napoleon, 1803: 1,171,931 square miles, including Alabama and Mississippi south of lat. 31° S.; the whole of Louisiana, Arkansas, Missouri, Iowa, Nebraska, North and South Dakota, Idaho, Montana, Oregon, Washington, and Indian Territory; Colorado and Wyoming east of the Rocky Mountains; Kansas, except the southwest portion south of the Arkansas River, and Minnesota west of the Mississippi. This was bought by Jefferson's administration for $15,000,000, $3,750,000 of it in assumption of claims of American citizens against France. The preliminary convention was signed by Livingston and Monroe 30 April 1803, and was confirmed by the Senate in special session 19 Oct. 1803, and by the House the 25th,— the extreme Federalists opposing it as unconstitutional, and the President acknowledging it to be so, but necessary.

(2) Florida (q.v.), 1819–21, from Spain: 59,268 square miles; price $5,000,000, entirely in assumption by the United States of claims of its citizens against Spain, and the relinquishment by it of claim to Texas and the boundary of the Rio Grande. The treaty was signed by the Spanish minister at Washington, 22 Feb. 1819; Spain refused to ratify it till after two years of vain insistence that the United States should refuse to recognize the independence of the South American States.

(3) Texas (q.v.), 1845: 376,133 square miles. Texas, originally part of the Mexican province of Coahuila, obtained its *de facto* independence in the war of 1836 against Mexico, was acknowledged by the other powers in 1837, and at once began the attempts for admission into the United States which had been the ultimate object of its first colonization by Southern settlers. In the previous April a treaty of annexation with Texas had been concluded, but was rejected by the Senate. President Tyler on the last day of his term sent a special messenger to secure the consent of the Texas Congress to annexation; it acceded unanimously, a popular convention of 4 July ratified the action, and the annexation was completed by a joint resolution of the United States House 16 Dec. 1845, and of the Senate on the 22d. It claimed west to the Rio Grande, taking in all the immemorially Spanish province of Coahuila, a circumstance which led to the Mexican war.

(4) New Mexico and Upper California, seized from Mexico in the war of 1847, and annexed by the treaty of Guadalupe-Hidalgo, 2 Feb. 1848: 545,783 square miles. Besides the present State of California it included Utah and Nevada, the most of Arizona and New Mexico, and Colorado west of the Rocky Mountains. Price, $15,000,000, and the assumption by the United States of $3,250,000 in claims of its citizens against Mexico. The portion of New Mexico east of the Rio Grande was claimed by Texas, which afterward received $10,000,000 from the United States in release.

(5) The Gadsden Purchase (q.v.), 1853, from Mexico: southern Arizona and New Mexico from the Gila valley to Chihuahua (the Mesilla valley), 45,535 square miles; price $10,000,000.

(6) Alaska (q.v.), 1867: 590,884 square miles; price, $7,200,000. Bought by the United States from Russia by treaty of 30 March, ratified by the Senate in special session 20 June.

(7) Hawaii, 6 July 1898; 6,740 square miles; price, a compensation to the queen, Liliuokalani, recently adjusted at $200,000. Annexed by a joint resolution of Congress.

(8) Porto Rico, the Philippine Islands, and Guam of the Ladrone Islands, 1898; taken from Spain as the result of war; ceded by Treaty of Paris, 10 Dec. 1898; about 150,000 square miles; price, $20,000,000, plus $100,000 subsequently paid for two small islands omitted from the treaty.

(9) Tutuila, with the smaller islets of Tau, Onesinga, and Ofu, of the Samoan group, 1899; 54 square miles, including the harbor of Pago-Pago; obtained by tripartite treaty with Great Britain and Germany.

(10) A number of small scattered islands in the Pacific, taken at different recent times, including Wake, January 1899. See UNITED STATES — *Territorial Expansion.*

An'nie Kil'burn, a novel of New England life, by W. D. Howells, published in 1888. It is a character study of a woman in her later youth who returns to her native town after a long sojourn in Rome, unfitted by her life abroad for sympathy with her girlhood friends, yet with no diminution in the strength of her Puritan conscience.

Anniston, ăn'nĭs-tŏn, Ala., a city in Calhoun County; on the Louisville & N., and Southern R.R.'s. It is in one of the most important coal- and iron-mining regions of the country; is a trade centre for cotton and agricultural products; and is noted for its manufactures of iron and steel, cotton goods, bricks, cordage, and other articles. Anniston is the seat of the Southern Female College and the Noble Female Institute; has three national banks, 30 churches, 10 daily and weekly periodicals, and a property valuation of $5,500,000. It was founded by the Woodstock Iron Co. in 1872. Pop. (1900) 9,695.

An'nuals, or **Monocylic Plants,** are those that complete their life histories — germinate, grow, mature, seed, and die — in a single vegetative period. In garden parlance the term is extended to plants that are preferably raised from seed planted each year. Annuals are especially common in dry climates and waste places, and among them are some of the most brilliantly colored and otherwise attractive of ornamental plants.

Annuals, in literature, the name given to a class of publications enjoying at one time an immense yearly circulation, and distinguished by great magnificence both in binding and illustration, which render them much sought after

as Christmas and New Year presents. Their contents were chiefly prose tales and ballads, lyrics and other verse. The earliest was the 'Forget-me-not,' started in 1822, and followed next year by the 'Friendship's Offering.' The 'Literary Souvenir' was begun in 1824, and the 'Keepsake' in 1827. Among the names of the editors occur those of Alaric A. Watts, Mrs. S. C. Hall, Harrison Ainsworth, Lady Blessington, and Mary Howitt. The popularity of the annuals reached its zenith about 1829, when no less than 17 made their appearance; in 1856 the 'Keepsake,' the last of the series, ceased to exist.

Annu'ity, a yearly payment of money to a specified person or persons, for a term of years, for life or perpetually. The varieties and combinations of annuity payments are almost as numerous as the contingencies or desiderata of human life; each having figured so largely in law as to receive a specific legal title. If the annuity is for a definite term of years, it is called an annuity certain; if forever, continuing to heirs or specified successors, a perpetual annuity or perpetuity; if for a limited period, a term annuity; if during the whole of a given period, not cut short by any contingent event, a whole-term annuity; if for a short period, a short-term annuity; if it does not begin till after a certain date, a deferred annuity; if not till after the occurrence of some specified event, a contingent annuity; if its beginning or duration is based on the continuance of a life or lives, it is called a life annuity; if for the time that certain persons survive, a temporary life annuity; if on any life provided another is living, or some event happen or not, a contingent life annuity; if it begin only after some death or deaths, a reversionary annuity; if for the duration of the longest of two or more lives, a joint-life annuity; if to the survivor of two or more, a survivorship annuity. There are increasing and decreasing annuities, their nature obvious from their titles. An annuity ceasing only with the death of the annuitant, and with a proportionate part of the next payment made to the heirs, is called a complete annuity; if it ceases with the last payment made to the living, a curtate annuity. This by no means exhausts the forms or combinations possible or even actual; nor does it fully define even those mentioned. Thus, in a joint-life annuity, what is to happen on the successive deaths up to the last? The shares of the dead might return to the estate, but in practice are successively added to those of the survivors in equal portions till the last survivor receives the whole. In contingent annuities the commonest contingency which terminates it is that the annuitant shall become self-supporting, as on marriage or remarriage or the attaining of majority; as when a man provides for his widow or daughter or son by will.

In respect of object, annuities may be broadly divided into two sorts: those providing for others and those providing for one's self. The former are probably the oldest, and are of course testamentary, taking the place of a legacy in the lump. Till modern times these were chiefly (and with great European houses are still so) charged directly on the private property of the testator in the hands of legatees or trustees. In Europe these permanent charges on property form a feature of the highest social and even political importance. The entailed estates are always incumbered with multitudes of annuities to connections or dependents of the houses, absolutely fixed, while the income from which they are to be paid may shrink indefinitely. But for a century and a half it has been gradually taken up by great incorporated companies and combined with the business of life insurance (q.v.). The insurance companies pay the annuities on contracts matured by the death of the testator, the payments beginning either then or at a specified time thereafter. In America this system has also absorbed almost entirely the old contractual annuities, in which the annuitants buy incomes for themselves by paying a lump sum to a person, company or public body for a term or life.

These contractual annuities, though based on the same calculations and mathematically identical, are historically of two distinct kinds as respects their object: the one seeking security, the other investment. The latter is the older, and resulted from conditions now obsolete; partly the paucity of investment securities, partly the laws against usury, which could be evaded by annuities, as a given sum was paid for by a return of services, and the element of interest did not formally enter into it at all. Hence the favorite method of borrowing money by the great mediæval companies and houses, and municipalities and States as well, was by annuities, sold on a rough estimate of the chances of life; in which the buyers were always keener than the sellers, and till very modern times the bargain was always against the payers of the annuity. Many shrewd investors accumulated great properties by careful selection of annuities on good lives, being allowed to propose the lives upon whose duration they laid this wager (until scientific mortality tables were constructed). The interest on government debts is a perpetual annuity; and of course any investment at interest is an annuity for its term, but such investments are not classed among annuities as the term is currently used.

The other object, that of securing one's self against the chances of fortune, though reached by the same means, has till recently had one broad distinction,— it was done at once and usually in early life, instead of in small lots as money accumulated. It was commonly the sinking of an inherited property (rarely an acquired one), by women, or by men of quiet tastes and unsuited for the struggle of business life, to produce a sure moderate income free from care and business chances. Naturally such annuities are much commoner in the older countries than in America, though steadily growing here from the same causes. Large inherited fortunes are rare in new countries, and the desire to live in unventuring ease equally so, but as family properties increase and the struggle for life grows harder, the annuity system grows likewise. But it has been vastly extended in recent years by its junction with the insurance system, enabling even relatively poor men to buy an income for their dependents after death, or themselves in old age, in small installments instead of an impossible lump sum; and also leaving to a widow a steady income for a term of years or life, in place of a lump sum to be invested by herself or trustees, and possibly

mismanaged or lost or embezzled. Therefore, both in its ease of purchase and in its advantages of payment, it is steadily growing in favor, and becoming larger in proportion to the total of life-insurance dealings.

Historically, annuities are probably as old as the great Assyrian-Babylonian times, in the 7th and 6th centuries before Christ, when great banking houses that lasted for generations, and commercial and mercantile facilities, were well developed; but the first positive mention is brought out by the Falcidian Law of Rome, 40 B.C., which enacted that not more than three fourths of a property should be willed away in specific legacies. As this could not be obeyed unless some method of valuing annuity legacies was devised, the following rough estimate was accepted: up to 30, 30 years more of life; up to 60, as many as were wanting to make up 60. This extremely defective calculation — which assumed that a life over 60 was not worth even a year's purchase, and was very inaccurate for others — was replaced by the great Roman jurist Ulpian (d. 228 A.D.) with one much better, though still imperfect; but interesting as the first known table of life probabilities graduated with reference to age, and, strangely enough, revived and used by the Tuscan government in the early 19th century, long after more scientific ones were in use. It is as follows:

Birth to 20,	30 years	44 to 45,	15 years
20 to 25,	28 "	45 to 46,	14 "
25 to 30,	25 "	46 to 47,	13 "
30 to 35,	22 "	47 to 48,	12 "
35 to 40,	20 "	48 to 49,	11 "
40 to 41,	19 "	49 to 50,	10 "
41 to 42,	18 "	50 to 55,	9 "
42 to 43,	17 "	55 to 60,	7 "
43 to 44,	16 "	60 and up,	5 "

This contained no interest computation. Until the 18th century there was little advance in the scientific aspects of the business: it remained a speculation, though an extensive and recognized one, and England under William of Orange may almost be said to have maintained her national existence by borrowing money on annuities, as the Dutch had to some extent before it. The researches of Pascal, Fermat, and Huygens in the 17th century into the theory of probabilities greatly advanced the accuracy of calculations; in 1742 Mr. Thomas Simpson published his 'Doctrine of Annuities and Reversions,' one of the landmarks of the business; and in 1762 the Equitable Assurance Society, the first insurance company of the world, was started primarily to do annuity business, which is the parent of life insurance, though now but a minor incident in it. Several other companies were founded shortly after. The real foundation of modern life insurance, however, and of scientific annuities as well, was the publication in 1771, by Richard Price, of his Northampton Table of Mortality. This estimated the term of life-average too low, but it was the predecessor of the Carlisle and other tables on which modern life insurance is built, now supplanted by the actual experience for generations in numberless great offices.

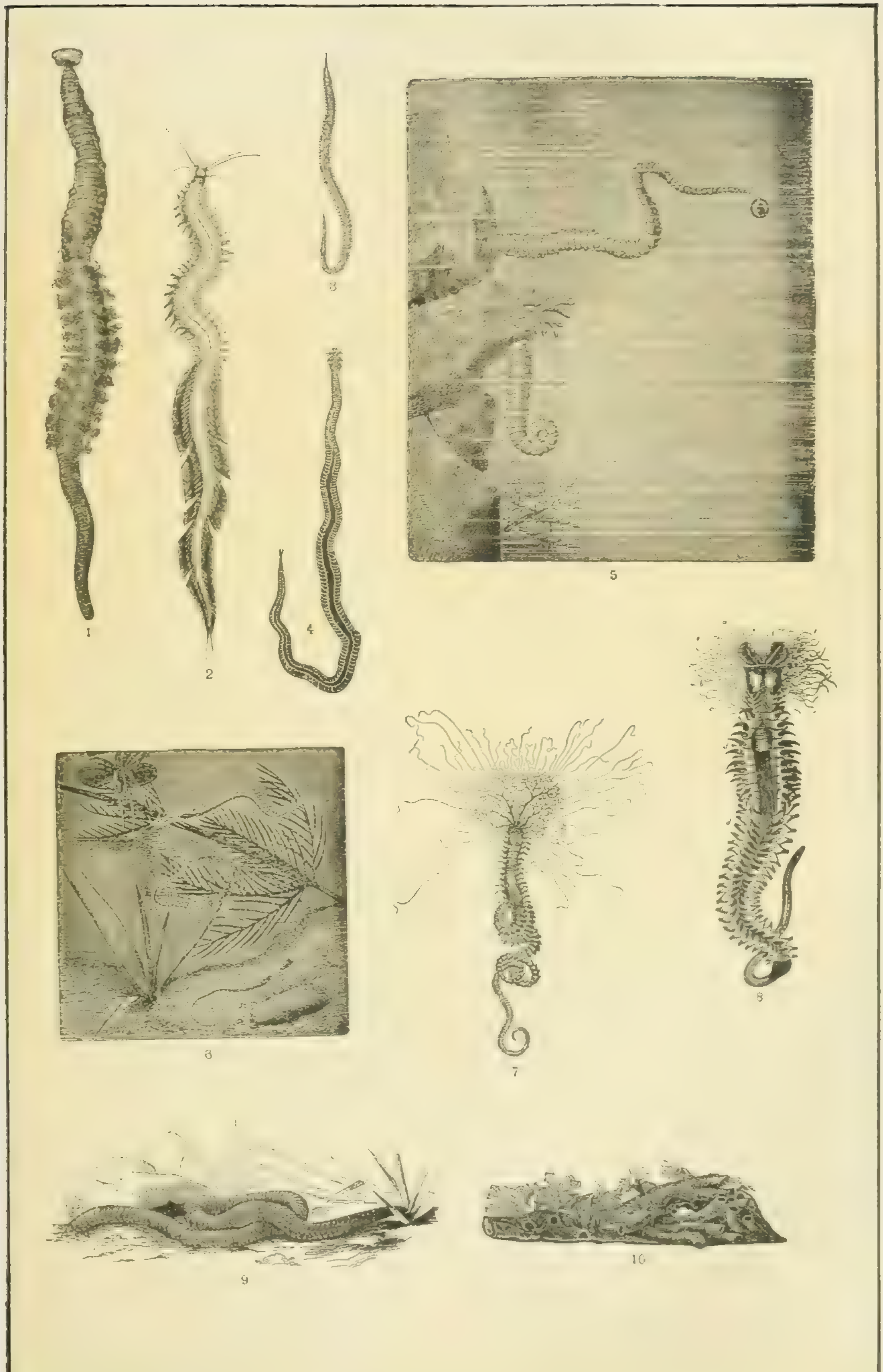
It is obvious that while the rate of mortality is a determining factor in annuity rates as much as insurance rates, its incidence is exactly in reverse. That is, the higher the rate of mortality and the shorter the average term of life, the less money in gross will have to be paid on a contingent annuity contract, and consequently the less will be the sum needed to sink in it, or in current phrase, the lower the rate of annual premium. Conversely, the older the buyer is, and consequently the shorter his expectation of life, the less his annuity is worth. On the contrary, the less an individual's expectation of life under an insurance contract, the higher must his premium be to accumulate sufficient money in the assumed period to amount to the promised sum. The factor of interest is the same for both: the higher the interest, the lower the premium or the initial sum paid. In the now frequent insurance contracts, where the principal sum is paid to the beneficiary in annuity installments, the question is one of interest complicated by the probabilities of the beneficiary dying before the payments are completed. More usually now, however, this latter element is eliminated by providing that in such case the remainder shall be paid to the legal representatives, so that it becomes an annuity certain. An interesting concrete illustration of the effect of overrating the mortality is the sale of annuities by the English government under the Northampton Table. This table had figured a correct total of deaths against an incomplete table of births in a given population, and consequently assumed too high a death rate; the government, therefore, fixed the annuity rate too low; and vast quantities of annuities were sold under Mr. Perceval's scheme of 1808 for funding the national debt. The actuaries discovered the miscalculation, and one of them in 1819 warned the government that it was losing £8,000 a month on these contracts; the advice was unheeded; buyers continued to be shrewder than the government and purchased largely of the attractive bargain, and in 1827 another actuary publicly announced that the government was losing £8,000 a week. The next year the sale was suspended, with a total loss to the government of not less than $25,-000,000.

The calculations for annuities are a part of actuarial science. In the United States the following are the approved rates of the best-managed companies: In consideration of $1,000 paid to a company the annuity granted to a person aged 40 would be $52.75; 45, $58.10; 50, $64.70; 55, $73.50; 60, $86.20; 65, $100; 70, $123.45; 75, $145.95; 80, $180.15. But, as stated, the pure annuity, sinking a large sum to buy a yearly income, does not figure largely in America.

Legally the annuity, whether charged to the person of the grantor or on specific real or personal estate, is treated as personal property except for purposes of inheritance or devisement, when it is held to be real property. A rent-charge, however, is a charge on specific real estate only, and is held to be real property under all circumstances.

An'nular'ia. See CALAMITIES.

An'nula'ta, or **Anneli'da,** a term applied to the phylum of sea-worms, comprising the most specialized worms. They are represented by the leeches, the earthworm, the nais of fresh water, and the marine annelids. The phylum is divided into four classes: (1) *Chætopoda,* (2) *Gephyrea,* (3) *Archi-annelida,* and (4) *Hirudinea.* In the more typical form they are characterized by their long, bilaterally symmetrical body,



1. Heteronereis.
2. Phyllodoce Laminosa.
3. Glycera.
4. Arenicola.
5. Rock Needle (Pontobdella muricata).
6. Nais Proboscidea.
7. Terrebilla Emmalina.
8. Hermella.
9. Common Earth Worm (Lumbricus agricola).
10. Tubes of Hermella Alveolata.

which is cylindrical, consisting of numerous segments either unarmed, or more usually provided with *setæ* alone, or with *setæ* and paddle-like appendages (*rami*). The head is simple, with a few simple eyes, or provided with tentacles (*antennæ*) alone, or with tentacles and *branchiæ*. An eversible pharynx, armed with teeth, is usually present. The alimentary canal is straight, the tubular stomach sometimes sacculated; the vent is always situated in the last segment of the body. The nervous system is well developed, consisting of a brain and a ventral ganglionated cord. The circulatory system is closed, with a dorsal and ventral, and lateral vessels connected by anastomosing branches in nearly each segment. A system of numerous paired segmental organs, the sexes are united in the same individual or separate. The embryo passes through a cleavage-stage (morula or blastula), gastrula, sometimes a neurula stage, and after hatching, development is either direct or there is a marked metamorphosis, the larva passing through a trochosphere and cephalala stage. Consult Parker and Haswell, 'Text-book of Zoology' (1897).

Annuncia'tion, the declaration of the angel Gabriel to the Virgin Mary that she was to become the mother of our Lord (Luke i. 26-38). Annunciation or Lady Day is a feast of the Church in honor of the annunciation, celebrated in the western Churches on 25 March. The institution of this festival is generally assigned to the 7th century. The Italian, formerly Sardinian, order of Knights of the Annunciation (*Ordine Supremo dell' Annunziata*) was instituted by Amadeus VI., Duke of Savoy, in 1360. It received statutes from Amadeus VIII. in 1409, was renewed in 1518, and raised to the first order of the Sardinian monarchy in 1720. The subject of the Annunciation has been a favorite with artists from Fra Angelico to Dante Gabriel Rossetti.

Annunzio, Gabriele d', ăn-noon'tse-ō, an Italian novelist and poet: b. near Pescara in 1864. He was educated at Prato, where he published at 14 his 'Primo Vere.' He is now one of the most conspicuous Italian writers of the day, having abandoned Italian traditions for modern French realism. His poems and novels are brilliant, but often frankly sensual as well as pessimistic, and both prose and verse have been severely criticised for their licentious spirit. 'Il Piacere,' his first novel (The Child of Pleasure, 1889), was followed by others entitled 'L'Innocente' (The Intruder, 1891); 'Giovanni Episapo' (1892); 'Il Trionfo della Morte' (The Triumph of Death, 1849); 'Le Vergini delle Rocce' (Virgins of the Rocks, 1896); 'Fuoco' (Flame of Life, 1900). His plays include 'Il Sogno d'un Mattino di Primavera' (1897): 'Il Sogno d'un Tramonto d' Autunno' (1898); 'La città Morte' (1898); 'La Gioconda' (1898); 'Francesca da Rimini' (1901). D'Annunzio's reputation is now international, his writings having been translated into English, French, and German. Among his poems are: 'The New Song' (1882); 'Interludes of Verse' (1883); and 'Marine Odes' (1893).

An'nus Mirab'ilis (Latin), «the wonderful year,» 1666. A year memorable for the great fire of London and the successes of British arms over the Dutch. Dryden has written a poem with this title, in which these events are described.

Ann'ville, Pa., a village in Lebanon County five miles west of Lebanon, the seat of Lebanon Valley College, an institution controlled by the United Brethren in Christ. It was founded in 1762. Pop. (1900) about 2,000.

Ano'a, a genus of Malayan buffaloes, particularly the small black species, with low, erect horns, called sapi-utan (*A. depressicornis*), and found in the highlands of Celebes. The genus was once classed with the antelopes.

Anob'ium, a genus of beetles belonging to the family *Ptinidæ*. It contains the death-watch insects, *A. striatum*, *A. tesselatum*, etc.

An'ode, the name given by Faraday (in 1832) to the electrode, or terminal, at which a current of positive electricity enters a battery or other electrical apparatus in which chemical work is performed. The term has since been extended so as to include the electrode by which a positive electric current enters a vacuum tube. The other electrode, in every case, is known as the «cathode.» The anode of a primary battery (see BATTERY) commonly consists of a plate or rod of zinc, while the cathode consists of a plate of carbon, or copper, or platinum. In electrolysis the anode and cathode both consist, usually, of platinum or carbon. In a vacuum tube the anode commonly consists of a wire or disk of platinum, while the cathode (which is varied in shape according to the purpose to which the tube is to be put) is usually made of aluminum or platinum.

An'o-don'ta, a subdivision of the fresh-water mussels (q.v.), abundant in the streams and lakes of the United States and most temperate countries. They have smooth, thin shells without hinge-teeth.

An'odynes. See ANALGESICS.

Anointing, an Oriental custom of applying oil to the head or unguents to the body. The Greeks and Romans, particularly the former, anointed themselves after the bath. Wrestlers used unguents in order to render it more difficult for their antagonists to get hold of them. The use of oil for ceremonial purposes is equally ancient. Its first mention is in Gen. xxviii. 18, where Jacob, in commemoration of a remarkable dream, is said to have set up a pillar and poured oil upon it. In the Mosaic law and several ancient religions a sacred character was attached to the anointing of the garments of the priests and things belonging to the ceremonial of worship. This could be done only with oil made for the purpose, and signified a consecration of the articles to the service of religion. Jewish priests and kings were anointed when inducted into office, and were called the anointed of the Lord, to show that their persons were sacred and their office from God. The Old Testament prophecies respecting the Redeemer style him, on account of his royal descent and his dignity, Messias, that is, the Anointed, which is also the meaning of his Greek name Christ. The custom of anointing still exists in the Roman Catholic and Oriental Churches (see SACRAMENTS), and is also frequently a part of the ceremony of coronation.

Anoka, ă-nō'kă, Minn., a small city, the county-seat of Anoka County, with manufactures of lumber, flour, and machinery. Pop. (1900) 3,769.

Ano'lis, a genus of slender, long-tailed, iguanid lizards of the American tropics, which are expert climbers and seek their insect food principally in trees and bushes. They have a pouch under the throat and the ability to change color. It is not surprising, therefore, that one of the species (*A. carolinensis*), a beautiful golden-green lizard, very common in our Southern States, and often kept as a pet, should be called the American chameleon. About 100 other species are known. See CHAMELEON.

Anom'aly, a deviation from a rule. That which deviates is called anomalous. In astronomy the true anomaly is the angle which a line drawn from a planet to the sun has passed through since the planet was last at its perihelion or nearest distance to the sun. On account of the planets not moving with the same velocity at all parts of their orbits, this angle does not increase uniformly; hence its name. The anomalistic year is the interval between two successive times at which the earth is in perihelion, or 365 days 6 hours 13 minutes 48 seconds. In consequence of the advance of the earth's perihelion among the stars in the same direction as the earth's motion, and of the precession of the equinoxes, which carries the equinoxes back in the opposite direction to the earth's motion, the anomalistic year is longer than the sidereal year, measured by the sun's return to the same position among the stars, and still longer than the tropical or common year, measured by the earth's return to the same equinox. It exceeds the latter by 25 minutes.

Anonaceæ, ăn-ō-nā'cĕ-ē, the custard-apple family, a natural order of trees and shrubs with simple, alternate leaves, destitute of stipules, by which character they are distinguished from the *Magnoliaceæ*, to which they are otherwise closely allied. Their flowers are commonly axillar, sometimes terminal. The calyx is persistent, with three deep divisions. The corolla is formed of six petals, disposed in two series. The stamens are very numerous, forming several series; their filament short, their anthers almost sessile. The carpels, generally aggregated in great number in the centre of the flower, are sometimes distinct, sometimes connected; each of them has a single cell which contains one or more ovules attached to the inner suture, and often forming as many distinct fruits (rarely one only in consequence of abortion); sometimes they are united together and form a kind of fleshy, scaly cone. The seeds have a horny endosperm deeply grooved, and this is another character which distinguishes them from the *Magnoliaceæ*. The *Anonaceæ* are mostly tropical plants belonging both to the Old and New Worlds, the papaw being the best-known American species. They are generally aromatic, a quality found chiefly in the bark, but also in the leaves and flowers, and to some extent in the fruit, all of which parts are consequently employed in the countries of which the plants are native as remedies and for seasoning. Many of them yield likewise an edible and nutritious fruit, extremely agreeable to the taste.

Anoph'eles, a genus of *Culicidæ* (mosquitoes), embracing those species of blood-sucking mosquitoes which carry and communicate to human beings, by biting, malarial diseases. See MOSQUITO.

An'oplothe'rium, an extinct primitive ruminant fossil in the Upper Eocene formations of Europe. It was among the first fossil vertebrates discovered in the gypsum quarries of Montmartre in Paris, and was named by Cuvier in 1822 from its defenseless character (Gr. ἄνοπλος, unarmed; θηρίον, beast), as it has neither tusks nor horns to protect itself from its carnivorous enemies. They form the type of a distinct family, in many respects intermediate between the swine and the true ruminants.

Anorthite, a triclinic feldspar, having the composition of a silicate of aluminum and calcium, $CaAl_2Si_2O_8$. It is especially interesting to the chemical mineralogist because it stands at one end of the albite-anorthite series of feldspars (see FELDSPARS). Its cleavage is perfect parallel with the base, and distinct parallel with the brachypinacoid. It is brittle, breaking with a conchoidal to uneven fracture. Its hardness is 6 to 6.5, and specific gravity about 2.75. It is usually colorless or white, sometimes grayish or inclining to brick-red. It occurs in glassy crystals in the ejected blocks at Mount Vesuvius, Italy.

Anos'mia, the loss of the sense of smell. This may be produced by: (1) Injury to the nerves of smell as they originate in the mucous membrane of the nose, in chronic nasal catarrh, in polypi, or in injury to the nose. (2) By injury to the olfactory bulbs or to the olfactory tracts. Such injuries occur in severe blows or falls, particularly in fracture of the ethmoid plate accompanying fracture of the skull. (3) By injury to the brain centres of smell, which are located in and about the uncinate gyrus. See SMELL.

An'selm, Saint, a celebrated theologian, regarded by some as the founder of scholasticism: b. Aosta, in Piedmont, 1033; d. Canterbury, 21 April 1109. At 27 he became a monk at Bec, in Normandy, whither he had been attracted by the celebrity of his countryman Lanfranc, then prior of the monastery there. When Lanfranc was promoted to the abbacy of Caen, Anselm was elevated to the dignity of prior, and in 1078 he was made abbot, which office he retained for 15 years. During this period he wrote his first philosophical and religious works: the dialogues on 'Truth and Free-will,' 'De Veritate,' and 'De Libertate Arbitrii,' and the treatises 'Monologion' and 'Proslogion,' and at the same time his influence made itself so strongly felt that Bec became the chief seat of learning in Europe. In 1093 Anselm was offered the archbishopric of Canterbury, which had lain vacant since the death of Lanfranc in 1089, and accepted the offer, though with great reluctance and with the condition that the king of England, William Rufus, should acknowledge Pope Urban in opposition to the antipope Clement, which the king ultimately consented to do. In 1097, a new difficulty having arisen between Anselm and William, the former set out for Rome to consult with the Pope. Urban received him with great distinction, but did not venture to declare himself on the side of the prelate in his dispute with the king. Meanwhile William had seized on the revenues of the see of Canterbury, which

he retained till his death in 1100. Anselm accordingly remained abroad, where he wrote his celebrated treatise on the atonement, 'Cur Deus Homo.' When William Rufus was succeeded by Henry I., Anselm was recalled. His canonization seems to have taken place in 1494. All the works of Anselm are directed toward founding a reasoned system of Christian truth. Such a system he considered to be a legitimate demand of reason, although he repeats again and again the doctrine that faith is necessary to the intelligence of the Christian mysteries, that the teaching of revelation must first be accepted by faith and afterward shown to have the support of reason. His celebrated ontological proof of the existence of God is to be found in the 'Proslogion.' The 'Cur Deus Homo,' treating, as already mentioned, of the atonement, is the most important of Anselm's works. In order to satisfy the reason of the need of an atonement and of the efficacy of the particular atonement that the Christian religion represents as having been made in the death of Christ, Anselm endeavors to establish the following positions: First, that God's honor is wounded by sin and his justice therefore requires satisfaction; second, that this satisfaction can be given only through one who is at once God and man; and third, that the voluntary death of Christ actually accomplished this satisfaction. The works of Anselm have often been published. The last complete edition forms the 155th volume of Abbé Migne's 'Patrologiæ Cursus Completus.' Among the numerous separate editions of the 'Cur Deus Homo' may be mentioned those of Lämmer (Berlin 1857) and Fritzsche (Zürich 1868). Anselm's personal character, distinguished by single-mindedness, gentleness, large-heartedness, and piety, makes him one of the brightest ornaments of the Christian Church.

Bibliography.— Eadmer, 'Vita Anselmi'; the works of Franck (1842); Hasse (1843–52); Rémusat (1853); R. W. Church (1870); Rigg (1896); and Welch (1900).

An'seres (Lat. nom. plur. of *anser*, goose), an order of water-birds, chiefly marked by the series of tooth-like projections on the edges of both mandibles, so placed that those on the upper mandible fit into the spaces between those on the lower when the mandibles are closed. Ducks, geese, and swans (qq.v.) belong in this order, and some classifications also include the screamers. They live and breed near the water, are found in all parts of the world, and are usually of large size. As a rule, they are swimming-birds and their numerous young need but little care. About 200 species are known.

An'son, George, Lord, a celebrated English navigator: b. Shugborough, 23 April 1697; d. Moor Park, 6 June 1762. He entered the navy at an early age and became a captain in 1724. In 1740 he was made commander of a fleet sent to the South Sea, directed against the trade and colonies of Spain. The expedition consisted of five men-of-war and three smaller vessels, which carried 1,400 men. After much suffering and many stirring adventures he reached the coast of Peru, made several prizes, and captured and burned the city of Paita. His squadron was now reduced to one ship, the Centurion, but with it he took the Spanish treasure galleon from Acapulco, arriving in England in 1744, with treasure to the amount of £500,000, after having circumnavigated the globe. His adventures and discoveries are described in the well-known Anson's 'Voyage,' compiled from materials furnished by Anson. His victory over the French admiral Jonquière, near Cape Finisterre in 1747, raised him to the peerage with the title of Lord Anson, Baron of Soberton. Four years afterward he was made first lord of the admiralty. In 1758 he commanded the fleet before Brest, protected the landing of the British at St. Malo, Cherbourg, etc., and received the repulsed troops into his vessels.

Anso'nia, Conn., a city of New Haven County, situated on the Naugatuck River, a few miles above its junction with the Housatonic, and on the New York, N. H. & H. R.R., being also the terminus of the New Haven and Derby branch. Two newspapers are published here, and the city contains two banks, many stores, public buildings, etc., besides extensive manufactories of brass and copper goods, clocks and clock equipments, movements, etc., electrical supplies, flour, lumber, and lumber products, foundries, and machine shops, etc. It was formerly a part of Derby, and received its city charter from the legislature in 1892. Pop. (1900) 12,681.

An'swer, in law, a defense in writing, made by a defendant to charges contained in a complaint filed by the plaintiff against him in a court of law. In all the code States a statute similar in its provisions to § 500 of the New York Code of Civil Procedure has been adopted. This section provides that the answer of the defendant must contain: (1) a general or specific denial of each material allegation of the complaint controverted by the defendant, or of any knowledge or information thereof sufficient to form a belief; (2) a statement of any new matter constituting a defense or counterclaim, in ordinary and concise language, without repetition.

Ant, a small social insect of the family of *Hymenoptera,* characterized by unusual distinctness of the three regions of the body, head, thorax, and abdomen, and by the stack or petiole of the abdomen having either one or (rarely) two "scales" or "nodes," so that the abdomen moves very freely on the trunk or thorax. The antennæ are elbowed as in wasps and bees. Ants live in societies, consisting, besides the males and females, of smaller wingless workers. In all ants except the *Odontomachidæ* and *Dorylidæ* the mandibles are wide apart at their base or insertion, so that they can be used without the other appendages of the mouth being opened or even moved. Both males and females are winged, but the males are much smaller than the females, while the wingless workers are smaller than the males. In these wingless forms the segments of the thorax become more or less separated, making the body much longer and slenderer, and less compact than in the winged normal sexual forms, the prothorax being more developed than in the males and females. The workers often consist of two forms: one with a large cubical head, or worker major, sometimes called a soldier, and the usual small-headed

form, or worker minor. In certain genera this polymorphism (q.v.) is still more marked. The legs are usually long and slender, the tarsi are five-jointed as usual in *Hymenoptera,* but the front or basal joint is disproportionately long, so that it functions as if part of the tibia; the tibias of the fore pair of legs are furnished with comb for cleaning the antennæ and mouth appendages. A sting is sometimes present, as in the *Poneridæ,* which sting like wasps and bees, and in the *Myrmicinæ,* while in the workers of ordinary ants it is either vestigial or entirely wanting. Some ants secrete an active poison (formic acid), which they inject into the wound made by their jaws in biting. In the *Formicinæ,* whose sting is atrophied, the amount of poison secreted is "relatively enormous" (Janet). Our *Formica obscuripes* is a very ferocious species, and, like the European *F. pratensis,* rises upon its hind legs, curves the abdomen, and ejects its venom, while Muckermann adds that the ejection of formic acid is so copious as to enforce the observer to momentarily retire.

The larvæ of ants are uniformly maggot-like, being legless, soft bodied, cylindrical, and with a small head bent on the breast. They are helpless and are fed by the workers.

Wheeler has shown that different species of ants employ very different methods of feeding their larvæ. Some (those of *Camponotus, Formica, Lasius,* and *Myrmica*) feed their young with liquid food regurgitated from their crops, and possibly also with the secretion of the salivary glands. Other species, however, *Ponerinæ* and some *Myrmicinæ,* feed their larvæ with comminuted insects. Wheeler states that the larvæ of certain ants "are not only able to subsist on solid food, but even on food of a vegetable nature."

The larvæ of the stingless genera usually spin a delicate silken cocoon, while those of the aculeate genera do not. Within the cocoon the larva transforms into the pupa.

Nesting Habits.— The history of a formicarium, or ants' nest, is as follows: The workers only (but in some species the winged ants) hibernate, and are found early in spring taking care of the eggs and larvæ produced by the autumnal brood of females. Every ant colony is founded by a single fertilized female. In the course of the summer the adult forms are developed, swarming on a hot, sultry day. The small yellow ants, abundant in paths and about houses in New England, generally swarm on the afternoon of some hot day in the first week of September, when the air is filled toward sunset with myriads of them. The females, after their marriage flight in the air, may then be seen entering the ground to lay their eggs for new colonies, or they are often seized by the workers and retained in the old colonies. Having no more use for their wings, they pluck them off, and may be seen running about wingless. The female, after laying her eggs, does not go abroad in search of food, but feeds the young larvæ with food regurgitated from her stomach and derived from her fat-bodies; thus the larvæ are poorly fed and become workers.

Nests.— The nests of some species of *Formica* are six feet in diameter and contain many thousand individuals. Ants also build nests of clay or mud and inhabit hollow trees. Ants in Europe build true mounds, sometimes three feet high, but in North America they are mostly subterranean, though in Wisconsin one ant (*F. obscuripes*) erects a true mound about 20 inches high.

Formica sanguinea is one of our most abundant species, making hillocks of sand or clay, according to the nature of the ground. From the formicary walks and underground galleries radiate in a labyrinth in all directions; and deep down, where the soil is perpetually moist, the galleries descend to a relatively greater depth than in Europe. Packard has found a variety of this species in Labrador, where it is common. It does not throw up hillocks, but tunnels in the earth. The nest of *Œcophylla smaragdina* is formed by drawing together a number of green leaves, which are united with a fine web. Some nests are a foot in diameter. This species swarms in hilly forests in New Guinea. Its sting is not very severe.

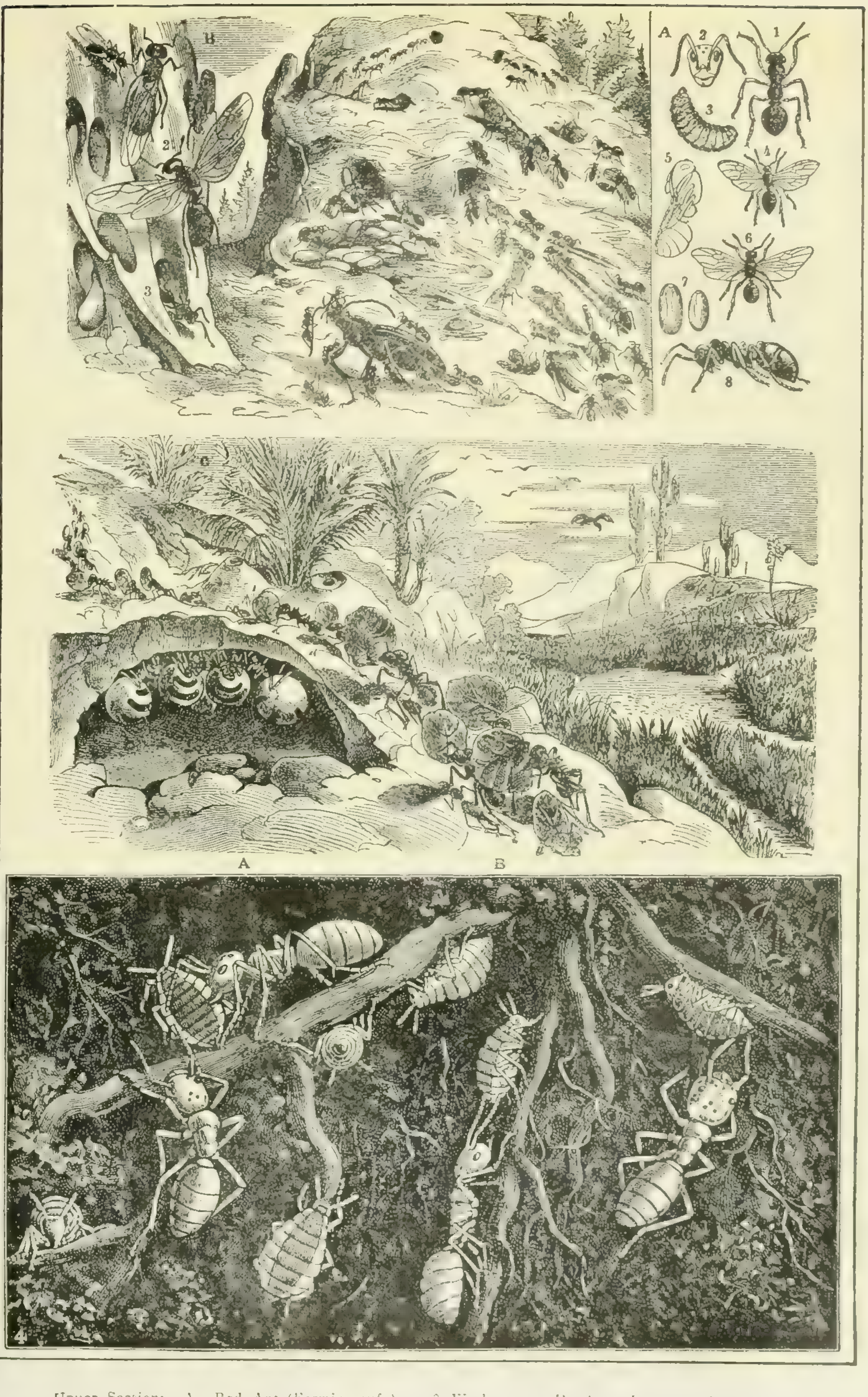
It is in argillaceous countries especially that the Œcodomas build their enormous formicaries, so that one perceives them from afar by the projection which they form above the level of the soil, as well as by the absence of vegetation in their immediate neighborhood. These nests occupy a surface of many square metres, and their depth varies from one to two metres. Very many openings, of a diameter of about one to three inches, are contrived from the exterior, and conduct to the inner cavities which serve as storehouses for the eggs and larvæ. The central part of the nest forms a sort of funnel, designed for the drainage of water, from which, in a country where the rains are often abundant, they could hardly escape without being entirely submerged if they did not provide some outlet for it.

The "agricultural ant" myth has been exploded by Wheeler, who shows that these ants do not plant grass seeds or "ant-rice" for a harvest. It is probable that Lincecum's error was due to the fact that the sprouted seeds stored up and then cast away as inedible take root and thus form a partial circle of tall grass around the nest.

Mushroom Gardens.— Möller has described what he calls "mushroom gardens" made by several South American species of *Atta.* The ants cut and bring the large pieces of leaves into their cellars, then cut them into smaller fragments, and finally comminute these still further till they form a flocculent greenish-brown pulp. This pulp is heaped up and soon becomes invaded by the mycelium of a fungus (*Rozites gongylophora*). The mycelium is kept aseptically clean — that is, free from all other species of fungi and even from bacteria — and induced to grow in an abnormal way by bringing forth minute swellings which constitute the only food of the ant colony. Möller likens these swellings to the *kohlrabi* of the German kitchen gardens.

Forel has studied the habits of two other species (*Atta cephalotes* and *A. sexdens*) in Colombia, in relation to this process of collecting and comminuting the leaves and in cultivating the mushroom. He has found that the largest workers (soldiers) triturate the leaves and defend the nest. They draw blood when they fight. The indigenes are said to use these insects for closing wounds. They induce them to bite the two lips of the wound, and thereupon sever the bodies from the heads, which then serve as a suture. The medium-sized workers cut the leaves from the trees, while in the nest the workers of the

ANTS.



Upper Section:— A. Red Ant (Formica rufa). 1-8. Workers. 2. Head. 3. Larva. 4. Male. 5. Pupa. 6. Female. 7. Egg. All magnified. B. Horse Ant (Camponotus herculeanus). 1. Male. 2. Female. 3. Worker.

Middle Section:—A. Honey Ant (Myrmecocystus Mexicanus). B. March of the Leaf-Carrying Ant (Œcodoma cephalotes).

Lower Section:—4. Yellow Ants (Lasius flavus), with Root Lice; highly magnified.

minim caste are forever clipping the threads of the mycelium of the *Rozites*, which then develops the *kohlrabi* on which the ants feed.

Wheeler has more recently excavated a large nest of leaf-cutting ants (*Atta ferrens*) in a piece of woodland in Texas. The large burrows, nearly an inch in diameter, were found to extend down to a depth of from three to five feet, and to open into large chambers, some of which were fully ten inches across and five to eight inches high. A few of these chambers were traversed by the roots of a large cedar, in the shade of which the ants had dug their formicary. Mushroom gardens were found heaped upon the floor, or, more rarely, enveloping, as aërial or «hanging» gardens, the roots that extended across the chambers.

The shape of a mushroom garden is that of a discoidal sponge. On its upper surface the ants pile up the flocculent vegetable débris, threaded in all directions with fungus hyphæ, in the form of thin, vertical, anastomosing plates, so that as much surface as possible is exposed to the atmosphere of the chamber. This atmosphere must contain a great amount of carbon-dioxid and a very small amount of oxygen. The ants leave several tubular or funnel-shaped openings, varying in diameter, and extending down into some chambers excavated in the base of the vegetable mass. In these chambers lives the huge queen of the colony (an insect nearly an inch long), the newly-fledged males and virgin queens, together with the larvæ, pupæ, and attendant ants. The whole mushroom garden swarms with workers representing all the different castes so characteristic of the genus *Atta*. The big-headed soldiers stalk about slowly over the surface of the comb, descending from time to time into the interior, as if to make sure that the great family is properly attending to its multifarious occupations, while thousands of *minims* keep moving about through the meshes of the mycelium, weeding the garden.

Relation of Quality and Quantity of Food to the Production of the Sexless Workers.— As is obvious, since the workers rarely lay eggs, the worker caste is not inherited either directly or collaterally from the parents. The view now suggested, and supported by a considerable body of facts, is that the larvæ on hatching are at first all alike, and that those which become workers are fed with different as well as less food than those which develop into sexual individuals. We know that the differences between the queen and the worker bees are due to differences in the nature of the food. The worker white ants have been found by Grassi to be the result of having different food and less of it than the males or females. Wasmann believes that the large workers of *Polyergus rufescens* («ergatoid females») are produced by the slave ants (*Formica fusca*), living in the colony, through excessive care and feeding of certain larvæ,— that is, that the *fusca* workers or slaves attempt to change worker larvæ of *Polyergus* into queens, but succeed only in producing the wingless ergatoids. Emery also holds that the sexual polymorphism of the ant colony is the result of the development of an instinct in the workers to feed the larvæ in different ways, and thus the characters in which the worker differs from the corresponding sexual forms are not congenital but acquired.

As has been said, the female ant, on founding a new colony, herself lives and nourishes the freshly-hatched larvæ with food from her stomach, ultimately from the fat-body. Hence these larvæ of the first brood are poorly fed and become small or dwarf workers (micro-ergates). These workers leave the nest and bring in food to their half-starved parent. Thus fed she becomes more prolific, lays another batch of eggs, and the larvæ become larger, and finally change into larger-sized workers. The colony thus becomes more populous and, as Wheeler states, the workers of successive broods grow larger until they attain the full stature of the species. Then and not till then do the workers bring up the males and queens, which are carefully herded, fed, and groomed by the workers until ready for the marriage flight. In some species of ants the males and virgin queens do not appear till the second or third year after the colony is founded. In a few American species of the huge cosmopolitan genus *Pheidole*, Wheeler and others find that the large-headed and small-headed or dwarf workers, are connected by a perfect series of intermediate forms, and this is due to the varying quantity of food. After an unfavorable season (autumn and winter) of drought and cold the number of *Pheidole* soldiers was unusually small. Thus Grassi's view as to the origin of the polymorphic forms in the termites being dependent on the quality and quantity is borne out by recent observations on ants.

Polymorphism and Variability of Ant Castes. — No solitary ants are known to exist, in all besides the males and females there are workers, and this is the direct result of their social mode of life. In our common species there is only one kind of worker, those in which the head is of uniform size, no big-headed ones or soldiers. But in ants collectively, though not in any one genus, there may be eight sets of individuals,— that is, ordinary males and «ergatoid» males, ordinary females and ergatoid fertile females, and exceptionally (*Formica rufa*), a set intermediate between the female and worker; there are also soldiers, worker-majors, and one or more kinds of worker-minors. The adult, sexually capable, though wingless forms, are called by Forel «ergatoids» from their resemblance to workers (Ἐργατης, a worker), this term is applied to both sexes. The worker females differ from the normal-winged female in the lack of a *receptaculum seminis*. The greatest number of castes in any one genus is five, occurring in *Eciton*, *Cryptocerus*.

Wheeler shows that polymorphism and variability depends on the amount and nature of the food and the increase in the population of the colony, and on the care and protection afforded to the reproductive individuals of the colony. There is, on the other hand, little variation in colonies which are poorly fed, and therefore unable to increase rapidly in number.

Primitive Ants.— Two primitive subfamilies of ants, the *Dorylinæ* and *Ponerinæ*, appear to have been evolved from a still more primitive and ancestral group, the *Cerapachynæ*, which Wheeler with good reason claims to be «the most archaic and generalized of existing *Formicidæ*. This group, species of which occur in Africa, southeastern Asia, Australia, and the southwestern United States (Texas) is repre-

sented in this country by *Cerapachys,* which mines the ground for a few inches under stones. The colony appears to be unusually small, the queen is wingless and the workers quite blind, and its life appears to be wholly subterranean, yet possesses senses of contact, odor (judging by the thick antennæ), and of hearing (it has "a beautifully developed stridulatory apparatus, which occupies the whole of the large membrane between the postpetiolar and first gastric segment") (Wheeler). This form, as Emery points out, seems to be the nearest of any ants to the *Mutillidæ,* especially the genus *Apterogyna,* which has an ant-like pedicel to the abdomen, and also resembles the ants in other features. That this group is also a very primitive one is shown by the plastic forms of females, of which there are four kinds, significant, as Wheeler remarks, "as the phyletic source to which the different female forms of all the subfamilies of ants are to be traced."

Slavery.— This phase of social life is not infrequent among ants, and it reacts upon the slaveholders by rendering them helpless. *Formica sanguinea* has been observed in Europe by P. Huber to go on slave-hunting expeditions. They attack a "negro colony" belonging to a smaller black species, pillaging the nests and carrying off merely the larvæ and pupæ. The victors educate them in their own nests, and on arriving at maturity the negroes take the entire care of the colony. *Polyergus rufescens* is also a slave-making ant, and Latreille very justly observes that it is physically impossible for the rufescent ants (*P. rufescens*), on account of the form of their jaws, and the accessory parts of their mouths, either to prepare habitations for their family, to procure food, or to feed them. *Formica sanguinea* sallies forth in immensely long columns to attack the negro ant. Huber states that only five or six of these forays are made within a period of a month, at other seasons they remain at peace. Huber found that the slave-making *Polyergus rufescens,* when left to themselves, perish from pure laziness. They are waited upon and fed by their slaves, and when they are taken away their masters perish miserably. Sometimes they are known to labor, and were once observed to carry their slaves to a spot chosen for a nest. The *Formica sanguinea* are not so helpless; they assist their negroes in the construction of their nests, they collect their sweet fluid from the *Aphides;* and one of their most usual occupations is to lie in wait for a small species of ant on which they feed; and when their nest is menaced by an enemy they show their value of these faithful servants by carrying them down into the lowest apartments, as to a place of the greatest security. Pupæ of both the slave-making species were placed in the same formicary by Huber, where they were reared by the "negroes," and on arriving at maturity lived together under the same roof in the most perfect amity. Darwin states that in England *Formica sanguinea* does not enslave other species.

In this country forays of a colony of *Formica sanguinea* upon a colony of a black species of *Formica,* for the purpose of making slaves of them, has been not infrequently observed. Slavery (*duloris*) is known to exist only between ants belonging to the same subfamily, the species of only four genera being known to practise slavery. In Europe the "paragon of dulotic ants" is *Polyergus rufescens,* or the "amazon" ant, as the workers are very warlike, though they are in other respects helpless and completely dependent on their slaves, dying of starvation if deprived of them. Darwin's explanation of the origin of the slave-making habits is that they were originally due to the predatory instincts of ants in general, seen in their carrying off the pupæ of other species, which, becoming stored as food, and, finally developing, would in their new abode do what work they could; and this habit of collecting pupæ for food might be rendered permanent for the purpose of raising slaves.

Sound Produced by Ants.— Certain species of ants are evidently not deaf, because capable of producing sounds which must be heard by others of their own kind. Thus *Myrmica rubra* has a sound-producing apparatus, a strigil, or file on the seventh abdominal segment (Janet); another ant of this group (*Sima læviceps*) is provided with a stridulating file; and in the ronerids there is a stridulating organ consisting of a band of very fine raised lines on the second segment behind the node. Other ants (*Polyrhachis*) tap on the surface of a leaf with their heads, producing a sound audible to human ears, as does an Assamese species by scraping the end of its abdomen on the dry leaves of its nest.

Senses of Ants.— While ants may be blind and deaf, none are known to be destitute of the sense of smell. The olfactory organs are little sensory pits in the antennæ. It is undoubtedly by means of their sense of smell that ants recognize the members of their own nest, and those of other species which they treat as enemies. It is probably by this means that they distinguish their friends from their enemies. Thus the cause may be the result of reflex action, rather than any special degree or kind of intelligence.

Parasitic Ants with No Workers.— Such are the ants of the genera *Anergates* and *Epœcus;* in the former the male and females are helpless, incapable of leaving the nest, and dependent on the attentions of the workers of another genus (*Tetramorium*) which live with them. This strange relationship seems thus far inexplicable.

Symbiosis in Ants.— The relation between ants and plants is very intimate, and it assumes different phases. See SYMBIOSIS.

Commensalism.— Ants' nests are so many apartment or boarding hives. A vast number of beetles, aphides, cockroaches, flies, and arachnids take up their abode in the nests of ants, where they are allowed by their willing or unwilling hosts to feed on the excretions of the ants themselves or their food. The fostering instincts of ants thus seem to be extended in various degrees to their guests and thus lay the foundation for this semi-parasitic community. Upward of 1,500 species of *Arthropoda* are known to live in more or less cordial relations with their hosts.

Bibliography.— Huber, 'Recherches sur les Moeurs des Fourmis Indigènes' (Paris and Geneva, 1810); Forel, 'Les Fourmis de la Suisse' (Geneva 1874); Lubbock, 'Ants, Bees, and Wasps' (New York 1894); McCook, 'The Natural History of the Agricultural Ant of Texas' (Philadelphia 1879); 'The Honey Ants of the Garden of the Gods,' etc. (Philadelphia 1882); Emery, 'Beitrage zur Kenntniss der

Nordamerikanischen Ameisenfauna' ('Zoolog-Jahrbuch,' Vols. VII. and VIII. 1893–4); Wheeler, 'The Compound and Mixed Nests of American Ants,' 'American Naturalist,' Vol. XXXV. (Boston 1901), with the writings of Darwin, Bates, Belt, Bethe, Emery, Fabre, Forel, McShering, Janet, Lincecum, Loeb, Mayr, Wasmann, and Wheeler. For a good list of the chief works on ants see Wheeler's 'Nests of American Ants' ('American Naturalist,' Vol. XXXV., p. 815).

A. S. Packard,
Late Prof. Zoology, Brown University.

Antacid, ănt'ăs-ĭd, an alkali, or any remedy for acidity in the stomach. Dyspepsia and diarrhœa are the diseases in which antacids are chiefly employed. The principal antacids in use are magnesia, lime, and their carbonates, and the carbonates of potash and soda.

Antæus, ăn-tē'ŭs, the giant son of Poseidon (Neptune), and Gē (the earth), who was invincible so long as he was in contact with the earth. But Heracles (Hercules), whom he challenged to combat, perceiving the secret of his strength, lifted him in the air and strangled him.

Antal'cidas, a Spartan statesman, chiefly known by the celebrated treaty he concluded with Persia at the close of the Corinthian war in 387 B.C. The peace which followed was styled "The Peace of Antalcidas."

Antali'kali, any substance which neutralizes an alkali, used medicinally to counteract an alkaline tendency in the system. All true acids have this power.

Antananarivo, ăn'tă-nä'nă-rē-vō, or Tananarivo, the former capital of Madagascar, situated in the province of Imérina. In recent years it has been almost entirely rebuilt, its old timber dwellings having been replaced by buildings of sun-dried brick on European models. It contains two royal palaces, immense timber structures, one of which is surrounded with a massive stone veranda with lofty corner towers. It has manufactures of metal work, cutlery, silk, etc., and exports sugar, soap, and oil. Pop. about 100,000, of which but few are Europeans. See Madagascar.

Antar, ăn'tär, or **Antara,** ăn'tă-ra, an Arabian warrior and poet of the 6th century, author of one of the seven Moallakas hung up in the Kaaba at Mecca, and the hero of a romance analogous in Arabic literature to the Arthurian legend of the English. This romance, which has been called the 'Iliad of the Desert,' is composed in rhythmic prose interspersed with fragments of verse, many of which are attributed to Antar himself, and has been generally ascribed to Asmai (b. 740 A.D.; d. about 830 A.D.), preceptor to Harun al-Raschid. See Hamilton's 'Antar: a Bedouin Romance' (1820).

Ant'arc'tic Regions, the name given to part of the earth's surface surrounding the South Pole. Its limits are variously defined by geographers; some consider it to be co-extensive with the Antarctic Ocean, which in a strict sense is bounded by the Antarctic Circle, while others include also that portion of the great Southern Ocean affected by Antarctic influences. According to the latter interpretation the region is approximately defined by the northern limit of the drifting pack-ice or about lat. 60° S., although icebergs are sometimes encountered as far north as lat. 45° S. The Antarctic region is surrounded by a great expanse of shoreless water which further north is divided by the continental lands into the Atlantic, Pacific, and Indian Oceans. The area comprised within the Antarctic Circle is about 8,200,000 square miles.

Exploration.— The early explorations into the region south of the equator and the discovery of numerous lands gave rise to the belief that a vast continent existed near the South Pole. The first voyage of Capt. Cook in 1769 showed, however, that New Zealand, contrary to the general opinion, was an island, and in his second voyage, in 1772, it was proved that the continent, if it existed, did not extend beyond the Antarctic Circle. In 1773 Cook sailed south again and the following year reached lat. 71° 10′ S. in lon. 106° 54′ W., where he was prevented from advancing further by enormous ice-floes. No land was seen on this voyage, although its presence was indicated by flights of birds. In 1819 Capt. Smith rounded Cape Horn and sighted the South Shetland Islands, while in the following year Alexander Land still farther south was discovered by Bellingshausen. Morrell, an English explorer, sailing in 1822, visited the Falkland Islands, Bouvet Islands, and South Georgia, and reported that he found the temperature of both air and water to be milder the farther he advanced southward. Biscoe circumnavigated the southern ice region in 1831–2, penetrating beyond lat. 67° S.; he discovered Enderby Land and its southwestern extension, which he named Graham Land. Kemp sighted and marked Kemp Land in 1833. The Balleny Islands were discovered by Balleny in 1839, and D'Urville, in 1839–40, made a long voyage, during which he visited many of the previously discovered lands, changing their names to make room for selections of his own. The latter also found Adélie Land, an immense tract situated far south of New Zealand and stretching for an unknown distance toward the Pole. The voyages of Wilkes (1838–42) and of Ross (1841–42) were of great importance, especially in their scientific aspects. Ross encountered land in 70° 41′ S. lat., 172° 30′ E. lon., which had a steep, rocky coast-line; farther south in 77° 32′ S. lat. he found a lofty, active volcano which he named Mt. Erebus and an inactive cone called Mt. Terror. He sailed for a distance of 450 miles along an unbroken ice barrier rising 150 feet above the water. During the next 30 years little was added to our knowledge of the Antarctic region. Dallman in 1873–4, however, visited many of the localities marked by previous explorers, and was able to confirm their reports. The Challenger expedition, which started out in 1874, returned with proof of a floating ice barrier and also accomplished a vast amount of oceanographic investigation. More recently the expedition of Gerlache, who penetrated to lat. 71° 36′ S., was fruitful in scientific results and added over 100 islands to the list of those previously known. Borchgrevink, a Norwegian, in charge of an English expedition, passed the winter of 1898–9 in the Antarctic and in the following summer reached lat. 78° 50′ S., the farthest then attained. In 1900 he set out again and succeeded in locating the south magnetic pole in

lat. 73° 20′ S., lon. 140° E. Three expeditions were fitted out in 1901 with a view of testing the theory of an antarctic continent; they are in charge of Scott (English), Von Drygalski (German), and Nordenskjöld (Norwegian). In March 1903 a vessel sent to relieve Capt. Scott's party returned to Auckland, N. Z., and reported that Capt. Scott had reached lat. 82° 17′; lon. 163°,— thus penetrating the farthest south recorded. See POLAR RESEARCH.

Antarctic Ocean.— The depths of the Antarctic Ocean have been explored in various parts by Ross, Wilkes, Nares (Challenger expedition), and Gerlache. Ross sounded in 4,000 fathoms in the vicinity of South Georgia without reaching bottom. The Challenger found depths of from 1,300 to 1,950 fathoms near the Antarctic Circle, south of Australia, while farther north the soundings ranged from 950 to 2,600 fathoms. Between the Cape of Good Hope and Kerguelen Islands depths of 2,500 to 3,100 fathoms have been reported. There seems to be a gradual shoaling of the waters toward the pole, for Wilkes sounded in 500 to 800 fathoms off Adélie Land and in 100 to 500 fathoms off Victoria Land, while Gerlache recorded less than 200 fathoms west of Palmer Land. The bottom in the extreme south is covered with a layer of diatom ooze composed of the frustules of diatoms which lived near the surface, together with shells of pelagic organisms and débris dropped by the floating ice. The diatom ooze has a chalky appearance when dried and is white or yellowish-white in color. Farther northward the bottom is covered with deposits of globigerina ooze made up of the casts of *Foraminifera,* and in still deeper water the characteristic red clay, found at great depths in all the oceans, occurs. The temperature of the surface waters of the ocean range from a few degrees below to a few degrees above the freezing point. Ross reported an average of 29.8° F. south of 63°, with extremes of 27.3° and 33.6°, and the Challenger found a temperature of 29° F. at 65° S. In the deepest water the temperature ranges from 32° to 35°, or about the same as is found elsewhere in the deep ocean.

Antarctic Continent.— The question whether there is a large land area of continental character within the Antarctic Circle has not yet been definitely settled, although most geographers and explorers express an affirmative opinion based upon strong evidence. In the first place land areas of indefinite extent have been sighted by Wilkes, D'Urville, Ross, Kemp, Bellingshausen, and others, and these areas together form an interrupted ring about the Pole. The mountain ranges and peaks discovered by Ross in Victoria Land are apparently of continental character, being composed of ancient crystalline rocks and rising from 7,000 to 15,000 feet above the sea. Granite and gneiss were found by D'Urville near Adélie Land, and Borchgrevink states that the rock at Cape Adare is mica-schist; these are distinctly continental types. Indirect evidence is furnished by the materials transported from the far south by the icebergs. Sandstone, basalt, and boulders of massive rocks were found by Wilkes on the ice, and the Challenger returned with fragments of gneiss, granite, diorite, and sedimentary rocks which had been dredged from the floor of the ocean. In addition fossil wood and shells of mollusks closely resembling forms found in the Tertiary rocks of Patagonia were discovered on Seymour Island. The great icebergs which drift far into the region of the Southern Ocean are difficult to account for on any other theory than that they have been broken off from a vast sheet of land ice like that covering Greenland. The meteorological phenomena, especially the system of winds prevailing within the Antarctic Circle, indicate continental land about the Pole. If it is assumed that Alexander Land, Victoria Land, Graham Land, Enderby Land, and other lands sighted by explorers represent the borders of the continent, its area would amount to approximately 4,000,000 square miles or about one half of the region comprised within the Antarctic Circle.

Antarctic Ice.— The conditions of ice formation in the Antarctic differ materially from those of the Arctic region. In the northern hemisphere the polar ocean is enclosed by land, so that sea ice is much more important than land ice, the latter occurring only on the edge of the area, while in the Antarctic the reverse is true. Enormous masses of floating ice, flat-topped with perpendicular walls and oftentimes measuring many miles in width and length, are found throughout the Antarctic Ocean. Wilkes and Bruce encountered icebergs 3 to 90 miles in length, extending 200 feet above the water and about 1,800 feet below, or about 2,000 feet thick. The newly formed bergs exhibit a parallel structure marked by the alternation of strata of snow-white and cobalt-blue ice in horizontal planes. They have evidently been broken off from the edge of a thick ice-cap covering the Antarctic lands and gradually pushed over the surface toward the sea. The thickness of the ice near the Pole is estimated by Croll upon theoretical grounds at from 12 to 14 miles, but such an enormous depth of ice seems hardly probable. Off the coast of Victoria Land the ice-wall is only 10 to 20 feet high.

Climate.— The climatic conditions of the Antarctic are imperfectly understood, but as regards temperature they may be characterized as extremely severe. Compared with the Arctic the region is placed at a disadvantage in having its summer during perihelion and winter in aphelion. Observations made by Ross in the vicinity of Victoria Land from 60° to 78° S. showed a mean summer temperature of 28.85° F. for the sea and 28.31° for air; in lat. 66° 29′ S. the maximum temperature in the month of December was 45.52° F. Wilkes found the mean temperature for January and February near Wilkes Land to be 30.2° F., with extremes of 34.52° and 23°, while Gerlache reported a winter minimum in 71° 30′ S. of —45°. The German station in South Georgia gave a mean temperature of 37.52°. The glaciation of the land areas, the great ice-floes, and the saturated condition of the atmosphere producing heavy fogs, are influential in producing the extreme cold. Barometric observations by Ross indicate a gradual increase in pressure south of 75° S., and it is believed that an area of extreme high pressure exists around the Pole, producing a permanent anticyclone with winds blowing in a southeasterly direction toward the higher latitudes. No estimate of the precipitation has been made, but the atmosphere is probably comparatively dry over the land areas in the extreme south and the precipitation is in the form of fine ice crystals. Farther north there is a

SOUTH POLAR REGIONS

heavy precipitation of snow and sleet; rain seldom falls within the ice-bound region.

Fauna and Flora.— The largest of the Antarctic mammals are the whales which frequent the cold waters in great numbers. Many of the species are similar to if not identical with those inhabiting the Arctic seas; rorquals, humpback whales, pilot whales, grampuses, and dolphins are known, also a small whalebone whale (*Balæna australis*), but the right whale does not exist in the Antarctic. There are 13 species of seals, including four of fur seals, which are closely related to those found in the North Pacific, the sea-lion and the sea-elephant. Among birds the penguins are most abundant, their rookeries being found on the borders of all lands free from ice. The largest species is the king penguin: a specimen captured by Wilkes measured 4 feet 6 inches in height and weighed 65 pounds. A gull-plover (*Chionis*) is found exclusively in the Antarctic. A small teal frequents Kerguelen, and stormy petrels, albatrosses, gulls, skuas, and terns breed on most of the islands. Borchgrevink found 11 species of fish in Antarctic waters, most of them new to science. Explorers have usually reported that fishes were scarce. A few species of insects have been described by Arctowski and Borchgrevink. It is believed that no land animals exist in the extreme south. Of plant and invertebrate life inhabiting the Antarctic Ocean there is a great abundance. The pelagic animals include cephalopods, brachiopods, and gastropods, which furnish food for the whales, cœlenterates, and *Protozoa*. The deep-sea fauna is much more strongly developed than the shallow-water fauna living in the vicinity of the Antarctic lands. Thirteen species of phanerogamous and numerous cryptogamous plants have been found near South Georgia. Hooker obtained from Cockburn Island four species of marine algæ, three of fresh-water plants, and twelve land plants, the last-named mostly lichens and mosses.

Antares, ăn-tā'rēz («corresponding to Ares» or Mars, because assumed to be like Mars in color), or *Alpha Scorpii*, a red double star of the first magnitude, the middle one of three in the body of the constellation Scorpio; much used by sailors in ascertaining longitude.

Ant'-bear', the great ant-eater, or tamanoir. See ANT-EATER.

Ant'-birds', a general term applicable to members of certain groups of birds within the *Formicariidæ* (q.v.), a South American group, all of which subsist largely upon ants. They have no proper oscine or singing organs, yet some of them have clear musical voices, and their notes of excitement when following the moving columns of destructive tropical ants, feeding not only upon them, but upon the insects they put to flight, are a warning which the natives understand and heed. All these birds are small and long-billed. The sub-family *Thamnophilinæ* is made up of the «ant-shrikes.» The «ant-wrens» belong to the sub-family *Formicivorinæ;* and the «ant-thrushes» are a species of the *Formicariinæ*, a typical sub-family. The pitta (q.v.) is also sometimes improperly called an «ant-thrush.»

Ant'-eat'er, a name given to several quite different mammals, but particularly applied to the *Myrmecophagidæ*, a South American family of *Edentata*, with the head extremely long; the snout slender; the mouth, ears, and eyes small; the tongue, long, cylindrical, and covered with a viscid saliva which holds whatever insects are licked up until the tongue can be withdrawn into the mouth. When not in use the tongue lies doubled up in the mouth. The legs are strong and heavy; the toes vary in number in the different species, but in all species are united as far as the base of the large claws, which are adapted to digging, but are turned under the feet when the animal walks. The great ant-eater, or ant-bear (*Myrmecophaga jubata*), found in tropical South America, is a sluggish animal, forest-dwelling, but entirely terrestrial; it grows to a height of two feet and a length of four feet, not including its long and very shaggy tail, which is often carried turned over its back like an umbrella. Though timid, it is capable of effective self-defense, using its strong fore-arms to hug and tear its opponents. Its body color is gray, set off by a black band which crosses the breast and tapers to the top of the shoulders, and by white feet and fore-legs. The hair is long, particularly on the back toward the tail, and on the tail itself. It is very unsocial, spending much time asleep, curled up with its tail spread over it as a protection from sun or rain. As more than one is seldom produced at a birth, the great ant-eater is not numerous.

Another, much smaller, species (*Tamandua tetradactyla*), which is also tropical, is arboreal and has a prehensile tail. It is about the size of a cat; its head is broader in proportion than that of the great ant-eater; its hair is bristly and short, black on the body, yellowish white on the head, neck, fore-legs, and hind-quarters. A third species (*Cycloturus didactylus*), the little or two-toed ant-eater, is still smaller than the tamandua, and is also arboreal. Its claws are curved and very sharp for climbing, and its whole structure is peculiarly adapted for life in trees.

Besides the animals of this family, called the true ant-eaters, are their allies, the scaly ant-eaters, or Manids (see MANIS), the aard-vark, the porcupine ant-eaters (see ECHIDNA), and certain insectivorous marsupials found in Australia and belonging to the genus *Myrmecobius*. Certain birds, such as the *ant-shrike*, are also called ant-eaters. (See ANT-BIRDS.)

An'tedilu'vian («before the flood»), theologically referring to the period previous to the Deluge recorded in Genesis. Geologically a term now disused, meaning before the waters of the earth had transformed its surface into the present form by submergence, erosion, etc.

An'telope (Greek, *antholops*, a horned animal), a bovine animal of the group formerly called the family *Antilopidæ*, now placed as a subfamily between the cattle and the goats in the family *Bovidæ*. Its members are all short-haired, lightly and gracefully built, and carry their heads uplifted: in size they vary from that of a kid to the height of a tall horse, and almost all are timid and fleet-footed. Although no very definite external differences separate the antelopes from the other groups of the *Bovidæ*, they are easily recognized by these general characteristics. Popularly, the antelopes include such widely varying species as the goat antelopes (the chamois and the Rocky Mountain

goat) at one extreme, and at the other the American prong-horn (q.v.), which has branched deciduous horns; but scientifically both these extreme forms must be excluded, and the term confined to Asian and African species having horns present in both sexes, the cores of which are solid, and which tend to grow upward rather than outward. To these rules there are exceptions, however, and a scientific distinction of the group from the cattle, and still more from the sheep, is very difficult.

Antelopes have been pronounced the most generalized of the living *Bovidæ*, and consequently are regarded as representing the form from which the other types within the family have descended. Their earliest fossil remains are found in the Miocene, when they flourished all over Europe and Asia, and their migration into Africa seems to have been comparatively recent. When Africa was first explored by Europeans, however, they were established there and had so enormously multiplied as to be the chief resource for meat of the natives and of carnivorous animals. Colonization so wasted and scattered them, however, during the latter part of the 19th century, that some species are already extinct, and others would be except for preservation on private estates.

Antelopes may be ranged in certain groups, such as the antelopine gazelles, including many species which are beautiful in form but do not often exceed 30 inches in height, with goat-like teeth, hairy muzzles, and ringed horns, usually either spiral or lyre-shaped. This group inhabits deserts from the Cape of Good Hope to India, and among them are the ariel and other gazelles, the springbok, the blackbuck of India, the saiga, and various others. Another, the Cervicaprine group, contains the little African reedbuck, the small klipspringer and rehbok, the tiny steinbok, and the larger waterbucks, etc. A third group comprises several African forest-ranging species, among others the pygmy antelope, only 13 inches tall and the smallest known ruminant. Another group is far larger and has many of the characteristics of cattle, while still another section diverges toward the goats. The largest, most beautiful and valuable group of all is that which contains the Indian nilgai and the African bushbuck and eland.

There is an erroneous notion abroad that antelopes all live in large bands, or even vast herds, that roam over flat plains and perform migrations in large bodies from one place to another as scarcity of food and the weather compel them. Instead of this uniformity, however, there exists great variety in size, shape, color, speed, agility, and habits, in adaptation to the varied circumstances in which they live. Some dwell altogether in mountains and are as expert in climbing about the rocks as are the goats. Others frequent forests and rarely leave their shade. Still others remain entirely among hills where dense thickets cover the rough surface, and dart in and out among the bushes so rapidly and expertly that the sportsman finds the greatest difficulty in getting a shot at them. Aquatic antelopes exist, especially in South Africa, where certain kinds, as for example, the reedbucks, spend nearly all their time in marshes, wading and swimming about and feeding upon aquatic vegetation. It is indeed only the larger, stronger, and better-armed kinds that can endure existence in plains where they have little means of protection against leopards, lions, and other enemies, and must trust entirely to escape by flight or by being overlooked. The result has been the development among them of great speed, but this has not been accompanied by endurance, since few are required or are able to continue to run swiftly any great distance. As an aid to their safety, nature has developed in the desert- and plain-dwelling species an adaptation in color to their surroundings, making them almost invisible when lying down or standing against the rock and thicket. As a rule their coats have the dull colors of a plains landscape, the only somewhat conspicuous markings being those upon the face and tail, which serve the purpose of "recognition marks" but are not sufficiently large to attract attention at any great distance. Sometimes this protective color of antelopes is very striking, as in the case of the red hartbeest of East Africa, which frequents the open country where the soil is rust-red and termite hills are exceedingly numerous. It is said that the most experienced hunters are constantly deceived by the exact resemblance between one of these antelopes when lying down and an ant-hill.

The flesh of most antelopes is regarded as excellent food and some of them yield meat that is most delicate eating. The hides of the larger ones make good leather, and the destruction which has overtaken the race in South Africa has been brought about mainly by hide-hunters. The horns were put to many uses by the native Africans and Asiatics and are still in demand for the making of fancy handles and other articles of ornament.

For additional information see BLACKBUCK; GAZELLE; GNU; HARTBEEST, and other names of groups and species in this family.

An'tenna'ta, a name given by Lang to a group of tracheate arthropods embracing his sub-classes *Myriapoda* and *Hexapoda* (*Insecta*). Consult Lang, 'Text-book of Comparative Anatomy' (N. Y. 1891).

Anthol'ogy ("nosegay"), a name originally given to a collection of short unconnected Greek poems from many sources, and till lately applied only to that and its various enlargements. In recent times it has been extended to any collection of detached pieces of miscellaneous authorship, prose or verse, to represent a language, a literature, a country, an epoch, or any sort of subjective idea as a thread on which to group it. The most famous anthologies of the past are the following:

The Greek Anthology.— This originated in a class of poems, invented by the Greeks,— the epigram, properly meaning mere inscription, and used for epitaphs, votive offerings, or other commemorative occasions. The modern restriction of the term to mean "short pungent witticism" is due to the characteristics of the original epigram imposed by its uses,— brevity, pregnancy, singleness of idea, and purity of style. Any piece which fulfilled this idea was later called an epigram by the Greeks themselves. The species was thoroughly developed and cultivated by the Alexandrian school. Polemon, Alcetas, and others made collections of poems on special subjects; but about 80 or 90 B.C. Meleager of Gadara in Syria, a poet and rhetorician, for the first time made a comprehensive selection from all the best Greek poems in this genus from

Sappho down, 46 in all, besides contributing 130 of his own. He called it *Stephanos*, 'The Garland'; and so great were his taste and judgment that no other collection has ever averaged so high in quality. It was the "Golden Treasury" of Greece.

In the 1st century A.D. one Philip of Thessalonica enlarged Meleager's group by 13 new poets and called the whole 'The Anthology.' Not very long after, the sophist Diogenianus again supplemented it; and under Hadrian, Strato of Sardis made a new collection called the 'Muse of Love,'— a very earthly muse. Under Justinian and after, there was a revival of epigram-writing by a literary circle of whom Agathias the lawyer and Paulus the Silentiary (privy councilor) were the heads, and who did some very beautiful work of this kind; and Agathias made a fresh collection based on Meleager, called 'The Circle,' divided into books, and for the first time arranged by subject.

There were therefore five Greek anthologies at the beginning of the Middle Ages. About the beginning of the 10th century, apparently, a monk named Constantinus Cephalas made a fresh gathering from these and from the works of other epigrammatists which had been published separately, classifying it after Agathias' fashion. For much of his matter we are indebted to this collection solely, the originals or earlier editions having perished. Another monk, Maximus Planudes, made a further recension, rather by mutilating Cephalas' work than by new research; though he added some on works of art and some of his own of little value. His edition was first published at Florence in 1594, and was for nearly two centuries the only one known to the public; that by Cephalas discovered in 1606 not being published until 1772. From its being found in the Palatine Library at Heidelberg this MS. is usually known as the Palatine MS. It represents over 300 poets of all ages of Greece, and therefore all sides and aspects of Greek emotion and poetic art as well as intellectual observation and reflection, with the greatest brilliancy and beauty.

Through all the ups and down of Greek civilization this series of poems forms a living bond closely united with the feeling and spirit of each age. To read it has been justly compared to excavating an ancient city, where the strata succeed each other with scarcely perceptible change, but form a continuous history of its development. Dr. Garnett divides it into four stages: The Hellenic, of which Simonides is the most typical, characterized by the bona fide nature of the inscriptions (not mere literary exercises), simplicity, dignity, and transparency: the Alexandrian era, of which Callimachus stands first, when it was a play of the imagination, often anecdotal, sportive, amorous, or satirical,— much richer and more interesting, less pure and sincere; the Roman-Oriental, of which Meleager is the greatest, luxurious, gorgeous, fanciful; this passes later into the modern epigram, stinging satire and lampoon, or ethical reflection; and finally, the circle of Agathias or the Byzantine school, imitators, but of real power and originality, of genuine feeling and much ingenuity and elegance of style. Its effect on European literatures has been enormous; it has supplied them with imagery, filled them with expressions that are household words with us, been a model of style most beneficial in inculcating brevity, simplicity, and accuracy of language, and a treasure-house of information as to life.

The best of recent translators are, in verse, J. A. Symonds and Richard Garnett; in prose, J. W. Mackail.

The Latin Anthology.—A selection of Latin poems from Ennius to about 1000 A.D., was formed by Peter Burmann the younger in 1759. The Romans had nothing corresponding to the Greek Anthology, though collections of sententious thoughts were published, and individual poets like Martial wrote books of epigrams and published them. The great Scaliger in 1573 made a collection of Latin pieces, and Pitthœus another and larger one in 1594. These were added to by others from time to time; but Burmann edited them all into his 'Anthology of the Ancient Latin Epigrams and Poems.' In 1869 Alexander Riese brought out the first volume of a better edition of the Latin Anthology (2d ed. 1894), discarding Burmann's arrangement and placing the poems found in MSS. first, the inscriptions following in another volume. As these Latin anthologies had no literary purpose, being designed only to preserve all fragments good or bad, so they have slight literary value as wholes, the good pieces being swamped by grammarians' exercises and conceits of worthless writers. Being mostly of late date they are not nearly so valuable historically as the Greek. There are also Arabic, Persian, Turkish, and other anthologies, including several by authors of the United States.

An'thon, Charles, an American educator: b. in New York city, 17 Nov. 1797; d. there, 29 July 1867. He was graduated at Columbia College in 1815 and admitted to the bar 1819, but never practised. He was adjunct professor of Greek and Latin at Columbia 1820–30, and full professor and head master of the grammar school connected with the college 1830–64. In 1835, in connection with the Harper publishing house, he projected a 'Classical Series' to include works used in academies, preparatory schools, and colleges. It proved the most successful enterprise of its kind ever undertaken in America. Of the more than 50 volumes edited by Anthon the following are the best known: an edition of Lemprière's 'Classical Dictionary' (1822); 'Horace,' with notes (1830); 'Dictionary of Greek and Roman Antiquities' (1843); 'Classical Dictionary' (1841).

Anthony, ăn'tō-nĭ, **Clemens Theodor:** b. 1755; d. 1836. King of Saxony, who succeeded his brother Friedrich August I. 5 May 1827. The French revolutionary movement of 1830, spreading to Saxony, compelled him to grant a constitutional government in 1831.

Anthony, ăn'tōnĭ, **Henry Bowen,** an American legislator: b. in Coventry, R. I., 1815; d. 1889. He was graduated from Brown University in 1833 and was editor of the Providence *Journal* for over 20 years. He was governor of Rhode Island in 1849 and 1850, and United States Senator from 1859 till his death.

Anthony, ăn'tō-nĭ, **John Gould,** an American naturalist: b. in Providence, R. I., 17 May 1804; d. in Cambridge, Mass., 16 Oct. 1877. Leaving school at 12 years of age he followed a business career for 35 years. He early developed

a taste for natural history, and his publications attracted the attention of Agassiz, through whom in 1863 he became head of the conchological department of the Museum of Comparative Zoology, a post he held until his death. He was a recognized authority on the subject of American *Mollusca*.

Anthony of Padua, Saint: b. Lisbon 15 Aug. 1195; d. in Padua 13 June 1231. Shortly after his ordination to the priesthood he was deeply stirred by the recital of the cruel martyrdom of five Franciscan missionaries whose bodies had just been brought from Morocco to Coimbra, where Anthony was then living. Having entered the Franciscan order, he soon started for Africa in the hope of being permitted to die for Christ. He had scarcely landed when illness obliged him to leave. Hearing about the general council of his order which was going on, he started for Assisi, where he met Saint Francis, the founder of the order. His profound knowledge of sacred things, joined to his sanctity, caused him to be made the first teacher in the Franciscan order and later on the Provincial of all the convents of the order in upper Italy. His feast is celebrated June 13.

Bibliography.—Coleridge, S. J., 'Life and Works'; Meyer, 'Leben des H. Antonius'; Lepitre, 'Saint Anthony of Padua,' translated by E. Guest (1903).

Anthony, ăn'tō-nĭ, **Saint,** the patriarch of monastic institutions: b. near Heraclea, in Upper Egypt, 251 A.D.; d. 356. Giving up all his property, he retired to the desert, where he was followed by a number of disciples, who thus formed the first community of monks.

Anthony, ăn'tō-nĭ, **Saint, Cross of,** a cross in the shape of the letter T, often styled the Tau Cross. In heraldry the name is given to two stripes, a horizontal and a vertical one crossing in the middle of the escutcheon.

Anthony, ăn'tō-nĭ, **Saint, Falls of,** a noted fall in the Mississippi River, within the limits of Minneapolis, Minn. (q.v.). The entire descent of the stream for three quarters of a mile is 65 feet. The falls and surrounding scenery are exceedingly picturesque.

Anthony, ăn'tō-nĭ, **Saint, Fire of,** a name now applied to a form of erysipelas. A distemper of this character became epidemic in France in 1089. Many miraculous cures having been effected by the imputed intercession of Saint Anthony, the order of Canons Regular of Saint Anthony was founded the next year for the relief of those afflicted with this disease. The order continued to exist till 1790.

Anthony, Sister, American nurse and nun, known before entering religious life as Mary O'Connell: b. Limerick, Ireland, 15 Aug. 1815; d. Cumminsville, Cincinnati, Ohio, 18 Dec. 1897. She came with her parents to this country in childhood and in 1835 entered the order of Sisters of Charity at Emmittsburg, Md., removing to Cincinnati in 1837, there to take charge of work in Saint Peter's Orphan Asylum. On the establishment of Saint Joseph's Orphan Asylum at Cumminsville, in 1854, Sister Anthony was placed in charge and the next year she was transferred to Saint John's Hospital, where she remained 10 years. The terrible slaughter at the battle of Pittsburg Landing appealed so strongly to her sympathies that with two companions she accompanied the noted surgeon, George C. Blackman, to Nashville to minister to the wounded, there winning her title of "The Angel of the Battlefield." She returned to Cincinnati on a hospital steamer with many wounded soldiers whom she cared for at Saint John's Hospital. In 1866 two prominent Protestant business men of Cincinnati purchased the United States Marine Hospital and transferred it to the Sisters of Charity in the hands of Sister Anthony. The name was then changed to "The Good Samaritan," and she remained in charge till 1882. Not only was she in charge of various institutions of her order, but was several times procuratrix of the community. She is buried at the mother house of Mount Saint Joseph and her grave is annually strewn with flowers on Memorial Day by the soldiers of the Grand Army of the Republic.

THOMAS P. HART, M.D.,
Editor 'The Catholic Telegraph,' Cincinnati, O.

Anthony, Susan Brownell, American reformer: b. South Adams, Mass., 15 Feb. 1820; d. Rochester, N. Y., 13 Mar. 1906. She taught school in New York in 1835–50, in 1852 assisted in organizing the Woman's New York State Temperance Society, and in 1854–5 held conventions in each county in New York, in behalf of female suffrage. In 1857 she became a leader in the anti-slavery movement, and in 1858 advocated the co-education of the sexes. She was influential in securing the passage by the New York legislature, in 1860, of the act giving married women the possession of their earnings, and guardianship of their children. In 1868, with Mrs. E. C. Stanton and Parker Pillsbury, she began the publication of the 'Revolutionist,' a paper devoted to the emancipation of woman. In 1872 she cast ballots at the State and Congressional election in Rochester, N. Y., to test the application of the 14th and 15th Amendments of the United States Constitution. She was indicted for illegal voting and fined, but the fine was never exacted. Her last public appearance of note was as a delegate to the International Council of Women, in London, England, in 1899. In 1900 her birthday was celebrated by an affecting popular demonstration in Washington, D. C., and she retired from the presidency of the National American Woman Suffrage Association, which she had held for many years. See 'Life and Work of Susan B. Anthony' (1898).

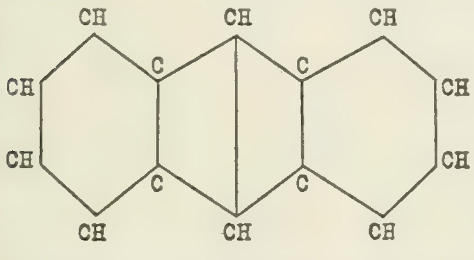
Anthony, ăn'tō-nĭ, **William Arnold,** an American physicist: b. in Coventry, R. I., 17 Nov. 1835. He was graduated from Yale Scientific School 1860, and taught science in various secondary schools 1860–67. He held chairs of physics and chemistry in Antioch College and Iowa Agricultural College 1869–72, was professor of physics at Cornell 1872–87, and consulting electrician, Manchester, Conn., 1887–93. Since the last-named year he has followed his profession in New York city and is professor of physics in Cooper Union School of Science. He has contributed many papers to the volumes of the scientific societies of which he is a member.

Anthosid'erite, ăn-thō-sĭd'ėr-īt (from the Greek *anthos*, "a flower," and *siderites*, "iron"), a mineral related to chloropal, occurring in fibrous tufts and sometimes in feathery forms resembling flowers. It is harder and heavier

than chloropal, is usually yellowish in color, and has the composition $2Fe_2O_3.9SiO_2.2H_2O$. It is found in Brazil.

An'thozo'a. See ACTINOZOA.

An'thracene (from *anthrax*, or *anthrac-*, "coal"), a hydrocarbon having the chemical formula $C_{14}H_{10}$, and the molecular structure



It is obtained by the distillation of coal-tar, occurring in that portion of the distillate which passes over at temperatures above 500° F. The "anthracene oil," as this part of the crude distillate is called, is allowed to stand in the cold for a week or so, until the greater part of the anthracene has crystallized out. The solidified portion when freed from the mother-liquor by pressure or by a centrifugal separator is ground up and washed with petroleum spirit to remove as much as practicable of the paraffin and other impurities. Anthracene so obtained is then sublimed and placed on the market as "50 per cent anthracene," although it may contain as much as 65 per cent of the pure substance. Its precise strength is best determined by treating a known weight with boiling glacial acetic acid and chromium trioxid, and observing the quantity of anthra-quinone that is formed. The crude anthracene of commerce may be further purified by distillation with caustic potash to which a little caustic lime has been added. Most of the impurities are removed in this way, and the product is further improved by subsequent washing with petroleum spirit, or with carbon disulphid, and finally by re-crystallization from a hot mixture of benzene and aniline. Pure anthracene crystallizes in white, monoclinic tablets melting at 415° F., and boiling at about 680°. It is insoluble in water and dissolves but slightly in other common solvents. It is soluble, however, in boiling glacial acetic acid, and also in hot benzene. It is used in large quantities for the manufacture of alizarin (q.v.). Anthracene is changed, by the action of sunlight, into an isomeric substance known as para-anthracene (or paranthracene), which melts at 472° F., and is reconverted into anthracene by fusion. See also COAL-TAR COLORS.

An'thracite, a variety of coal distinguished from other coals by its high proportion of carbon and small quantity of volatile matter. It has a conchoidal fracture, bright lustre, dense black color, and superior hardness. The percentage of carbon is variable, ranging from a minimum of about 80 per cent to a maximum of 95 per cent. Anthracite grades by imperceptible stages into bituminous coal, from which it has been produced by the action of heat or intense pressure. The coal-seams of eastern Pennsylvania are included in a series of strata which have been compressed and thrown into folds, while westward in the bituminous fields of Pennsylvania and Ohio the strata lie nearly horizontal. Beds of bituminous coal are frequently observed to grade into anthracite in the vicinity of igneous intrusions, as at Crested Butte, Colorado, and near Santa Fé, New Mexico. Where the heat has been very intense, however, the volatile matter is entirely driven off and graphite is formed.

Anthracite occurs in extensive deposits in many parts of the world. The most productive deposits are those of eastern Pennsylvania which occur in several detached fields, located as follows: The Northern field extending through the middle of Luzerne and Lackawanna counties; the Eastern Middle, between the Lehigh River and Catawissa Creek; the Western Middle, between the eastern headwaters of the Little Schuylkill River and the Susquehanna; and the Southern, or Pottsville field, extending from the Lehigh River at Mauch Chunk southwest to near the Susquehanna River. These fields comprise an area of something over 480 square miles and are classed under three general divisions, namely, Wyoming, Lehigh, and Schuylkill regions. The Bernice field in Sullivan County produces a semi-anthracite coal and is sometimes included with the anthracite fields. The strata with the beds of coal have been upturned and the outcropping edges subjected to long-continued erosion. The most important and persistent seam is the Mammoth, which in the Eastern Middle field has a thickness of from 60 to 90 feet and is over 100 feet thick in parts of the Southern and Western Middle fields. Altogether the workable seams number 15 or more, with a total thickness (increasing from west to east) ranging from 70 to 150 feet. The anthracite fields of Colorado and New Mexico are of much less importance. In foreign countries anthracite is mined in South Wales, Ireland, Belgium, France, Westphalia, and Russia, and it is known to occur in very large deposits in the province of Shan-Si, China. In the South Wales field only the northern portion yields anthracite, the rest of the output being semi-bituminous and bituminous coals.

Owing to its cleanliness and freedom from smoke anthracite is especially suited for household fuel; for steaming and metallurgical purposes it is inferior to bituminous coal. It ignites with difficulty and burns slowly with little flame, giving out intense heat. The amount of ash is small, ranging from 15 per cent to 6 or 7 per cent. The color of the ash is sometimes used as a basis of classification in trade, as in Pennsylvania anthracites, which are denominated white-ash and red-ash coals. But the color depends entirely upon the amount of iron present and is no criterion of the value. The following analyses show the relative proportions of fixed carbon, volatile matter, ash, etc., in various anthracites:

Fields	Fixed carbon	Volatile matter	Water	Sulphur	Ash
Eastern Middle, Pa....	86.38	3.08	4.12	1.62	5.92
Southern, Pa..........	83.81	4.27	3.09	0.64	8.18
Crested Butte, Colo..	82.33	9.96	0.81	0.81	6.96
South Wales..........	92.42	5.97	....	....	1.60

The preparation of anthracite for the market consists in freeing it from slate and dust and

sorting it into suitable sizes. Owing to the practical absence of volatile matter, anthracite will not burn unless the lumps are of fairly uniform size. When hoisted from the mine it is first passed over a screen which allows most of the fine coal to pass through. The lump coal is then sorted for the purpose of removing the shale and slate, and the pure material is crushed between rolls and screened into the market sizes. In the United States the sizes generally recognized are the following: Broken or grate, which passes through a screen of 4-inch mesh but not through 2.5-inch mesh; egg, 2.5-inch-1.75 inch: stove, 1.75 inch-1.25 inch; chestnut, 1.25-inch-0.75-inch: pea, 0.75-inch-0.50-inch; and buckwheat, 0.50-inch-0.25-inch. Larger sizes than the above are known as lump and steamboat, and smaller sizes as rice, mustard-seed, etc. The sizes from broken to chestnut inclusive are known as the domestic prepared sizes and constitute at present about 60 per cent of the output. The waste or fine coal which commonly amounts to as much as 10 per cent of the material mined is known as culm. Immense heaps of this fine coal have accumulated at the mines, but with the improved processes of screening and separation much of it is now saved and sold to manufacturing plants.

The growth of the anthracite mining industry in the United States has been very rapid. There are records showing that Pennsylvania anthracite was used for fuel as early as 1768, but mining was not carried on to any extent until about 1820. The growth of the industry from this time to the close of the century is shown in the following table:

	Long tons		Long tons
1820	365	1870	16,182,191
1830	174,734	1880	23,437,242
1840	864,379	1890	36,615,459
1850	3,358,899	1900	45,107,484
1860	8,513,123		

The production and value of Pennsylvania anthracite and the number of employees engaged in the industry during the period 1897-1901 were as follows:

	Production long tons	Value	Number of Employees
1897	46,974,715	79,301,954	149,557
1898	47,663,076	75,414,537	145,184
1899	53,944,647	88,142,130	139,608
1900	51,221,353	85,757,851	144,206
1901	60,242,560	112,504,020	145,309

Almost the entire output of anthracite is consumed as domestic fuel. A small portion is used for manufacturing purposes in large cities, but it is being gradually superseded for this purpose by the cheaper bituminous coal. See COAL.

Anthrac'nose, a group of fungous diseases caused by various species of *Glœosporium* and *Colletotrichum,* which appear upon the green parts of plants as roundish spots with more or less sunken light centres and darker margins. They often cause serious damage to cultivated crops, especially grape, strawberry, raspberry, spinach, egg-plant, cotton, and cucumber, under which titles they will be more fully discussed. For methods of control see FUNGICIDE.

An'thracother'ium, an extinct pig-like animal, inhabiting Europe and North America during the Oligocene and Miocene epochs. The teeth are intermediate between those of pigs and ruminants, but it is not in the direct line of descent of either, forming a side branch which left no descendants. The name, given by Cuvier in 1822, means "beast of the coal" (*ἄνθραξ* coal, *θηρίον* beast), and is derived from the fact that its remains were first discovered in the Tertiary lignite beds of France.

Anthraquinon'e, ăn'thra-quĭn-ōn' (from *anthra-cene* + *quinone*), a substance derived from anthracene by the action of oxidizing agents, and used in the preparation of alizarin. It may be conveniently prepared on a small scale by dissolving anthracene in glacial acetic acid, adding potassium bichromate, and heating to 212° F. The acetic acid is then distilled off, and the anthraquinone precipitated by water. On the large scale sulphuric acid is used in the place of the acetic acid. Anthracene has the formula $C_{14}H_8O_2$, and is insoluble (or nearly so) in water and alcohol, and but slightly soluble in benzene. It dissolves in hot sulphuric acid, separating out again, without change, upon cooling.

Anthrax, the name of a disease occurring epidemically among herbivora, chiefly oxen and sheep, and occasionally affecting man. It is also called malignant pustule, splenic fever, wool-sorters' disease, charbon, milzbrand. It is caused by a rod-shaped bacterium, the *Bacillus anthracis,* first seen in 1849 and isolated in 1863, and conclusively proved by Koch in 1876 to be the cause of the disease, this being one of the first diseases demonstrated to be caused by bacteria.

In man the bacillus is usually acquired by handling the hide of an animal having died from the disease. A local lesion, the malignant pustule, is formed, and this may lead to wide-spread infection with œdema and lymphatic invasion, attended by fever, gastro-enteritis, collapse, and death. The infection may remain localized, however, and the patient may recover. Less often the infection takes place in the respiratory tract, the patient having breathed the bacillus in the dust arising from handling hides or sorting wool; in such cases a rapidly fatal form of hemorrhagic œdema may develop. A still rarer form of the disease in man affects the intestinal tract. The bacillus of anthrax is one of the largest of the pathogenic bacteria. It is 6-8 microns $\left\{\frac{6\text{-}8}{25{,}000}\right\}$ inches long and 1.5 microns thick, being a short rod with square edges, and growing in chains. The protoplasm is finely granular and it forms spores about the centre of the bacillus. It grows very rapidly on all of the commonly used bacteriological culture media, best at a temperature of 35° C., but its multiplication ceases at temperatures below 12° C. or above 45° C. The bacilli are readily killed by temperatures of 60° C., but the spores are very resistant, and dry heat at 140° C. must be applied for several hours to kill them. In a dry condition they remain viable for several years and will resist boiling water for at least five minutes. The gastric juice

also does not destroy them readily. The bacteria are found in the blood and throughout the organs of animals dying of anthrax. They are particularly numerous in the spleen and in the lymphatic structures. They poison the body by the development of a toxin or toxins which in turn cause degeneration of the tissues of the body.

Anthrax is one of the diseases in which a serum therapy was instituted early. Thus far it has not proved of signal service, although a protective serum has been made by which animals may be immunized against the disease.

Anthrax in animals is a comparatively common disease, affecting sheep, cattle, and, more rarely, horses and members of the deer family. It is rare among the carnivora. The disease is not geographically confined, and animals in various parts of the world are affected by it. It is naturally less common in countries in which there is some legislative control, and rarer at present than in former times. In Britain the mortality is small; in France, at one time, as many as 10 per cent of the sheep died annually of anthrax. Since the modern method of immunizing cattle has been introduced the mortality has been much lessened. The symptoms vary widely, but at least three marked groups are observable. In some instances the affected animal develops symptoms of extreme collapse; it drops to the ground; the pulse and respiration are quickened, there is difficulty in breathing, and the animal dies in convulsions within a comparatively short time. A commoner type of attack is begun by symptoms of general distress, the animal is "off its feed," the pulse and respiration are quickened, chills develop, the temperature rises to 103 or 104° F., bloody diarrhœa occurs, bloody nasal catarrh. There then may develop convulsive movements; there is rapid loss of strength, and the animal may die in from 10 to 48 hours, sometimes at the end of 3 to 4 days. A third type is characterized by a slow onset, the lymphatic structures are involved, they swell and form carbuncles, which may ulcerate. General symptoms of infection may develop — the spleen may enlarge, bloody discharges are common, and the animal dies of generalized hemorrhagic œdema. The diagnosis is readily made in all cases by a microscopical examination of the blood. Different animals show marked variations in susceptibility. The sheep, save Algerian, ox, guinea-pig, and mouse, are all very susceptible, but the goat, horse, deer, and pig are less often attacked. Man may be placed next in the order of liability; the white rat, adult carnivora, birds, and amphibia are immune. The disease is conveyed to animals largely by way of the intestinal canal. The bacilli are ubiquitous in the grass and hay about an infected area.

Preventive inoculation.—Pasteur first evolved a method of inoculation by an attenuated virus, a sort of hardening the animal, as it were, that subsequently made it resistant to the virile bacteria. Although other methods, notably the use of anti-anthrax serum, have been used, the attenuated virus method seems to give the best results. Surgical methods are the only mode of treatment for man.

References.— Pollender, 'Vierteljahrschrift für Gerichtliche Medicin, VIII.'; Davaine, 'Comptes Rendus Acad. des Sciences,' 57, p. 220 *et seq.;* Koch, 'Cohn's Beiträge,' Vol. II., 1876. For all later literature see Flügge, 'Die Mikroorganismen'; Sternberg, 'Manual of Bacteriology'; Bureau of Animal Industry Reports, United States Department of Agriculture.

An'threnus. See CARPET BEETLE.

An'thropoid Apes, a term applied to those apes (family *Simiidæ*) nearest in their organization to man. See APE.

An'thropol'atry, the worship of man, a term always employed in reproach. It was applied by the Apollinarians to the orthodox Christians of the 4th and 5th centuries, who in their devotion to Christ worshipped, as was declared, only a man in whom God dwelt.

An'thropol'ogy (from Greek *anthrōpos,* man, and *logos,* doctrine), the science or branch of knowledge dealing with mankind in its most general aspects and characteristics, and as forming an organic whole. It derives its materials from the most varied sources, and rests upon other sciences, among which may be mentioned physiology, psychology, ethnology, archæology, ethics, and the study of religion, the rise of arts and science, and the history of civilization. Anthropology takes account of the totality of the moral and physical characteristics of man and of the different races of man; deals with the ethnological relationship existing between the races of former times and those now living, treats of man's place in nature, the relation in which he stands to the animals whose structure most nearly approaches his own, and the theory of evolution and development from lower to higher forms as applied to man. Anthropology considers also the how, when, and where of man's first appearance on the earth, the condition in which he originally existed, and the influences, means, and methods which have given rise to existing civilization. (See ARCHÆOLOGY; CIVILIZATION; ETHNOLOGY; MAN.) Consult: Tyler, 'Introduction to the Study of Man and Civilization' (1881), and see also the bibliography appended to the next article.

Anthropology, American. Although anthropology, or the science of man, is sometimes classed among the older branches of knowledge, it is, in its modern aspects, the youngest of all. Its relations to the older sciences are seen clearly when the object-matter or the special phenomena treated in the several sciences are compared. The special phenomena considered in the simplest of the sciences are cosmic bodies controlled by gravity,— that is, by a wholly external force. The phenomena treated in the second of the objective sciences in order of development are elementary, and their substances controlled especially by affinity, though incidentally by gravity,— that is, in part by what may be considered intrinsic forces, though chiefly by extrinsic factors. The phenomena dealt with in the next science in order of development (and also in complexity) are plants, of which the essential property is vitality, which is superadded to affinity and gravity; and the phenomena are controlled in considerable measure by intrinsic forces maturing in heredity. The object-matter of the next science, or group of sciences, is animals, whose special property is motility — a property coexisting with the vitality, affinity, and gravity of the simpler

sciences; and among the self-motile organisms the controlling forces are largely intrinsic. In the remaining class of natural phenomena, or mankind, the special property is that of mentality, superadded in turn to the special attributes of the simpler classes; and through the possession of this property mankind rise largely above environment and pass under the control of essentially intrinsic forces, merely adjusted to such external forces as those of gravity, affinity, etc. Viewed thus with respect to primary-object matter, the sciences are seen to fall into a natural series expressing at once the order of historical development and the degree of complexity. The series is of interest not merely as showing the place of anthropology among the sciences, but as indicating the breadth of the foundation on which the science of man is built; it may be deemed the offspring of all the older sciences, and borrows methods and principles from all; yet it occupies an essentially distinct field, defined by a special attribute existing only in organized bodies and playing the leading role only in the single sapient species of a unique genus — *Homo sapiens*.

While anthropology treats of a single class of phenomena, these are of such variety and complexity that the field of the science is broad — indeed, the general science may properly be regarded as made up of a number of special sciences of which several were cultivated long before the full extent of the human science was appreciated. The order of development of these special sciences is of much interest, and well illustrates (as does the history of science in general) the passage of definite science from the abnormal to the normal and from the remote to the near. Probably the first of the anthropologic sciences which came up in prehistoric times was pathology: certainly the least developed savages known to students are cognizant of pathologic conditions and possess systems of action and thought connected with those conditions. Probably, too, the second germ of definite knowledge related to physiology; for primitive folk usually display some notion of the normal reverse of pathologic conditions, and impute physiologic properties to animate and other bodies even before the organs are clearly defined. It is probable also that a mystical etiology followed, leading to a thaumaturgic or sortilegic practice which may be called primitive medicine and surgery; certainly during prehistoric times such major operations as trepanning were performed in many widely separated regions, with greater frequency than in modern hospital practice, and with fair if not excellent success, despite the fact that the diagnosis was wholly irrational and the apparatus and processes astonishingly crude. Within the historical period these primitive systems were gradually rendered definite and rational chiefly through the practice of the healing art; and as the spirit of exploration and discovery advanced, thought was stimulated by observations on other races; yet it was not until after Linné, Cuvier, and others laid the foundations for botany (or phytology) and zoology that the science of man began to take definite form. In the centuries from Linné to Darwin and Huxley man was regarded either as entirely outside the domain of scientific research or else as an animal genus merely; and during this period most students were content to investigate the purely physical (and individual) characters of the genus. Through the researches of the times anthropology was raised to a place among the recognized sciences, and various special methods were introduced, notably, anthropometry (including craniometry); the science of the time being that which is now commonly called physical anthropology, or somatology. Concurrently with the objective investigations, studies of the mental attributes of mankind were carried forward, and a fairly definite system of introspective psychology grew up. The development of physical anthropology and introspective psychology may be deemed the gift of Europe and of 17 centuries to the science of man. With the extension of colonization in America, the pioneers were brought into contact with alien tribes; these were objects first of curiosity and afterward of careful study with a view to the maintenance of amicable relations. The great lesson of the contact was the discovery that the actions and thoughts (or the conduct) of the alien folk were of immeasurably greater consequence than their physical characters. It was soon perceived that the key to primitive thought is the language by which it is expressed; and John Eliot, in Massachusetts, with scores of other students and missionaries, mastered the languages of the tribesmen with the view of promoting harmony and friendship. The early work was that of philanthropists and statesmen rather than scientists; but Gallatin went so far beyond his predecessors as to classify the American aborigines on the basis of language, thereby laying the foundation for a new anthropology, or a science of human activities. Morgan extended the study to the social organization of the tribes, and Brinton to their mythologic or religious systems; while, still later, Powell brought the earlier studies together and developed the science of human activities, which he called demology, or demonomy. It is to be noted that the unit of demology is not the individual, as in physical anthropology or somatology, but the group — the pair, family, clan, tribe, city, or nation. This science itself covers so broad a field that subdivision has been found convenient. Accordingly recent workers recognize a science of arts, or æsthetology, treating of the characters and the natural history (or development) of æsthetic symbols and devices; a science of industries, or technology, which treats similarly of implements, tools, machines, and other industrial instrumentalities; a science of laws, or sociology, dealing with the characters and development of social organization and institutions; a science of languages, or philology, devoted to the study of human speech and writing; and a science of philosophies, including myths, opinions, beliefs, and attendant customs and observances, which is conveniently called sophiology. With the progress of research and the definition of the special sciences it became clear to American students that while the human characters may conveniently be interpreted in terms of physical activities, they may be still more conveniently and simply expressed in terms of psychic or mental activities. Following this mode of interpretation it has been found feasible to classify mankind in four great

groups, each representing a fairly well-defined stage in intellectual, social, and moral development. The first of these stages is that commonly called savagery, in which law is based on kinship traced in the female line, and in which language and belief, as well as the arts and industries, are more or less inchoate. The second is that of barbarism, or patriarchy, in which the law rests on kinship traced in the paternal line, and in which arts, industries, languages, and faiths attain distinctive development. The third (sometimes connected with the second through feudal systems) is that of civilization, or the phase of civilization characterized by monarchical government, in which the law rests on recognition of property right, especially in land; this stage is characterized by writing, conventional art, differentiated industries, and especially by the Christian religion. The fourth stage is that properly called enlightenment, in which the law rests on recognition of human rights to life, liberty, and the pursuit of happiness, and in which arts are perfected, industries multiplied, languages blent and simplified, and faiths refined and ennobled. The recognition of these stages reacted on the primary motive of modern anthropology, and led to a clearer view of the significance of mentality not only in human affairs but in the economy of the universe. Accordingly anthropology may be said to have contributed to human knowledge one of the five cardinal principles of science. The first of these, contributed chiefly by chemistry, is the indestructibility of matter; the second, established by the aid of several sciences, is the conservation of energy or the persistence of motion; the third, derived largely from biology, is the development of species; the fourth, obtained by comparison of several sciences, is the uniformity of Nature; while the fifth, contributed by modern anthropology (although forecast by Bacon in his *Novum Organum*) is the responsivity of mind. The applications of these principles, especially that last named, are innumerable and highly useful; in large measure they give shape to the anthropologic researches of recent times.

Various instrumentalities for anthropologic research have grown up in America, especially during the last quarter of the 19th century. Perhaps the most efficient of these is the Bureau of American Ethnology, established in 1879 through the efforts of J. W. Powell; its work has been directed wholly to the aborigines, yet the researches have been so shaped as to bring out the essential principles of demology, or the science of mankind considered in a collective aspect. Important investigations have been conducted also in various museums, notably, the American Museum of Natural History in New York, whose work has been greatly enhanced through the Jesup North Pacific expeditions, organized as a part of the Museum establishment. The Peabody Museum connected with Harvard University, the Field Columbian Museum of Chicago, the Free Museum attached to the University of Pennsylvania, the Golden Gate Park Museum of San Francisco, and the Carnegie Museum of Pittsburg, have also made rich contributions to the science of anthropology in America, while the United States National Museum has been a centre of richly productive activity. Various volunteer organizations have served to guide and co-ordinate the work of individual investigators. One of the most influential of these has been the Anthropological Society of Washington, a pioneer in systemizing anthropology. It is organized in sections corresponding to the principal divisions of the science, namely: A, somatology; B, psychology; C, æsthetology; D, technology; E, sociology; F, philology; G, sophiology. Another efficient organization is the American Ethnological Society, with headquarters in New York; while the section of anthropology of the American Association for the Advancement of Science until recently afforded the sole opportunity for national gatherings of anthropologists. The Archæological Institute of America and the American Folk-Lore Society may be said to occupy portions of the field; and a number of other societies and sections have encouraged research. In the summer of 1902 a national organization of anthropologists was created, under the title American Anthropological Association; its membership includes the leading anthropologists of America. Several universities and colleges support anthropology either through established chairs or otherwise; Columbia, California, Chicago, and Harvard offer excellent facilities for both instruction and research in anthropology.

As customarily defined in American writing, anthropology includes ethnology and archæology, but does not embrace the closely cognate science of psychology. This science has been successfully cultivated in America during recent years; departments of experimental psychology are maintained in several universities, two or three excellent journals are conducted, and the experimental science is co-ordinated with the older, or introspective, psychology so effectively that America must be placed in the foremost rank, if not in the lead, of the countries in which the science is undergoing development. The special instrumentalities and results are indicated elsewhere.

Ethnology, or the science of races, ranks among the more important aspects of anthropology. Until the last quarter of the 19th century it was customary to define the races of mankind on the basis of color, character of hair, form of head, stature, color and attitude of eyes, and various other physical characters; and most of the applications of anthropometry and craniometry were made in connection with the description of races (ethnography) or in the systematic classification and discussion to which the term ethnology is properly applied. The ethnic characters recognized by various students are numerous and diverse; many are of local or special value only; and the definitions of races have been nearly as numerous as the writers on ethnologic subjects. The number of human races recognized by different authors varies from four or five to several score; but the modern tendency is to recognize only four or five leading types as ethnic varieties, or distinct races of mankind, namely, (1) the Caucasian or white race, (2) the Mongolian or yellow race, (3) the Malayan or brown race, (4) the American or red race, and (5) the African or black race. The principal American contributions to the subject of ethnology have been made since 1875, when Powell began the classification of the aboriginal tribes on the demotic

basis,—that is, on the basis of the human activities. As the studies progressed it was found that the native tribes (and other primitive peoples as well) might be classified on the basis of æsthetic or industrial character, on the basis of belief, or mythology, and still more satisfactorily on the basis of social organization, or law; but that the most convenient classification was that on the basis of language. Accordingly Gallatin's classification was revived and extended to the aborigines of North America (chiefly north of Mexico); and the thousand or more tribes known through current research and early record were grouped in some 60 linguistic stocks. These are as follows, in alphabetic but not geographical order:

	Tribes		Tribes
Algonquian	36	Natchesan	2
Athapascan	53	Palaihnihan	3
Attacapan	2	Piman	7
Beothukan	1	Pujunan	26
Caddoan	9	Quoratean	3
Chimakuan	2	Salinan	2
Chimarikan	2	Salishan	64
Chimmesyan	8	Sastean	1
Chinookan	11	Serian	3
Chitimachan	1	Shahaptian	7
Chumashan	6	Shoshonean	12
Coahuiltecan	22	Siouan	68
Copehan	22	Skittagetan	17
Costanoan	5	Takilman	1
Eskimauan	70	Tanoan	14
Esselenian	1	Timuquanan	60
Iroquoian	13	Tonikan	3
Kalapooian	8	Tonkawan	1
Karankawan	1	Uchean	1
Keresan	17	Waiilatpuan	2
Kiowan	1	Wakashan	37
Kitunahan	4	Washoan	1
Koluschan	12	Weitspekan	6
Kulanapan	30	Wishoskan	3
Kusan	4	Yakoan	4
Latuamian	4	Yanan	1
Mariposan	24	Yukian	5
Moquelumnan	35	Yuman	9
Muskhogean	9	Zuñian	1
Nahuatlan	?		

In connection with the classification of the tribes much information has been gained as to the migrations and other movements of the aborigines. As indicated by the linguistic diversity, the red race is by no means to be considered a unit; it comprises, on the contrary, an assemblage of distinct or slightly related peoples, whose movements must have been largely independent during many centuries of prehistoric time. There was, indeed, a strong tendency toward the absorption of weaker tribes by stronger, and toward the enlargement of groups by confederation; the most important confederacies of North America being the Iroquoian confederacy or "Six Nations," the Dakota or Sioux confederacy or "Seven Peoples," the Muskhogean confederacy of the eastern Gulf slope, and the indefinitely known Nahuatlan or Aztec confederacy of Mexico. The courses of migration of typical groups have been traced. The best known example is that of the Siouan Indians, who apparently pushed up the Atlantic coast, perhaps under pressure from a southern competitor, to Chesapeake Bay, by which they were diverted inland; reaching the habitat of the buffalo, which crossed the Appalachian Mountains in the neighborhood of the Potomac River, they followed this easy food source westward, across the mountains, down the Ohio to the Mississippi, and thence in northern and southern columns (the "up-stream" and the "down-stream" people) far out on the great plains, where most of the Siouan tribes were found by Caucasian explorers. There are clear indications that many of the Algonquian tribes also pushed inland from the northern Atlantic coast, spreading over the Lake region largely through the effective aid of the birch-bark canoe; and there are similar indications that the Athapascan tribes of the northern portion of the continent likewise pushed from the coast toward the interior and southward into the Pueblo region by means of the same simple transportation device; while the Eskimo clung to the coasts, pushing east to northern Greenland and west to and across Bering Strait into northeastern Asia. The intertribal relations farther south on the Pacific coast were such as to force maritime peoples into the arid interior, along the cañons and upon the plateaus — where some of the Pueblo tribes, like the desert peoples of the Gila Valley, still retain clear vestiges of a cult of the sea. On the whole, the traces of tribal migrations clearly indicate a tendency to move inland from the coasts and substitute agricultural habits for the simpler customs of fishery and chase. Naturally all inquiries bear on the question of the peopling of America; but it is significant that the careful researches of a quarter-century have added practically no evidence of the peopling of the New World from the Old — the only known aboriginal crossing of Bering Strait being that by the Eskimo migrating west. The records of the Jesup expedition tend to indicate that traditions were carried from America to Asia during prehistoric times, but not in the other direction; while certain studies of cultivated plants suggest a westerly migration from South America to Polynesia, and no trustworthy indication of aboriginal immigration has been found. A few ethnologists incline to the opinion that mankind developed in America earlier than in Asia, and passed westward perhaps during the Pliocene or the early Pleistocene; but the dearth of human relics of geologic antiquity tends against this opinion. Some of the most competent students favor the view that howsoever the human prototype may have been introduced in America, the tribes originated independently before speech was developed, and that since this early time the lines of development have converged; so that the prescriptorial history of America may be likened to the written history of Europe, in which tribes, peoples, languages, and customs have progressively blent and united throughout the last two millenniums. On the whole it must be said that ethnologic researches have thus far failed to answer many of the mooted questions concerning the origin and early movements of the American aborigines; yet it is not to be forgotten that they have resulted in the fullest and most faithful descriptions of primitive men ever given to the world.

The ethnologic inquiries in America have constantly stimulated archæologic research — indeed, the special merit of American archæology grows out of the fact that the American interpretations of relics are based on actual observation of primitive peoples rather than on inferences peculiar to an entirely distinct culture stage. In general, archæology, as the term is employed in this country, may be defined as a special aspect of anthropology; more strictly, it

represents the archaic or prehistoric division of technology and æsthetology. In many respects America has been found to afford a peculiarly instructive field for the archæologist: relics of the Stone Age abound in unequaled profusion; the great mounds and earthworks of the Mississippi Valley are practically unique; the cemeteries, filled with fictile ware in North America, and the rich huacas of the Andes, are without parallel elsewhere; the ruined cities of Yucatan, Mexico, and Peru have awakened the interest of the world; and all of these monuments of the past may be, and most of them have been, studied in the light of surviving customs of the descendants of their makers. The investigation of relics pertaining to the arts has supplemented the studies among living tribes, and has shown that æsthetic concepts arise in symbolism and pass through a crude conventionalism before they mature in faithful representations; and in like manner the prehistoric industrial devices fall into a series coinciding with that found among living tribes, which passes from the symbolic first to the conventional and only long afterward to the simply useful. Thus, the earliest weapons were teeth, claws, beaks, or shells of animal tutelaries; in the next stage they were imitations of the natural weapons; the devices next underwent slow modification, determined by the character of the material; and in a relatively advanced stage of thought the germ of invention was introduced. The tracing of the development of industrial devices of primitive men is one of America's chief contributions to the science of archæology; and it is especially significant by reason of its conformity with the course of social development established through ethnologic researches. The sequence is a direct record of growing mentality; and it runs from the stage in which men thought as beasts up to that in which some of the aboriginal tribesmen were able to meet Caucasian invaders on terms of approximately equal psychic development. The record indicates that perhaps the longest step in industrial development was that leading to the use of the edged implement of stone or other material; and that next to this the hardest step was that leading to the smelting of metals, which some of the aborigines had just approached at the time of the Columbian discovery. The principal stages in industrial development, attested alike by the prehistoric relics of America and the customs of the lowest living tribes, are as follows:

Some of the more interesting archæologic investigations of the western hemisphere relate to the antiquity of man. From time to time discoveries of human relics in deposits of geologic antiquity are reported, and it has become customary for archæologists and geologists to visit the localities and investigate the associations critically. In most cases the examinations have led to the rejection of the evidence on one ground or another, so that very few cases can be regarded as indicating extreme human antiquity in the western hemisphere. There is, indeed, a strong presumption that man has lived in the western world many thousands of years; almost certainly he was there before the last ice invasion, possibly before the first advent of Pleistocene ice; for otherwise it would be difficult to account for the differentiation of the Eskimauan from the Athapascan and other peoples, to explain the development of complex social organization by the slow processes of primitive life, or to understand various other lines of development — yet the tangible evidence remains meagre. Probably the most trustworthy indication is that afforded by an apparently wrought human femur, reported by Putnam, from the glacial gravel at Trenton.

The finding of a human skull at a considerable depth in apparently undisturbed deposits near Lansing, Kansas, has attracted much attention, but the modern aspect of the cranium and the uncertainty as to the age of the deposits greatly weaken its testimony. On the whole, the conservative American archæologist is compelled to rest the case for the higher antiquity of man on the western hemisphere rather on a strong presumption than on decisive evidence of relics in deposits of known geological age. See ARCHÆOLOGY (*American*); INDIANS; MOUND BUILDERS.

Bibliography.— Abbott, 'Primitive Industry' (Salem 1881); Baldwin, 'Ancient America' (1872); Dellenbaugh, 'The North Americans of Yesterday' (1901); and 'Reports' of the Bureau of American Ethnology (Washington), since 1880.

W J McGEE,
Smithsonian Institution.

An'thropom'etry (from the Greek *anthrōpos*, man, and *metron*, measure), a term denoting the science having for its object the systematic examination of the height, weight, and other physical characteristics of the human body. In 1875 the British Association appointed a committee to collect observations in con-

STAGES IN INDUSTRIAL DEVELOPMENT.

STAGES	TYPICAL MATERIALS	TYPICAL PRODUCTS	ESSENTIAL IDEAS
1. Zoomimic	Bestial organs	Awls, spears, harpoons, arrows	Zootheistic faith
A. Transitional	Symbolized organs	Piercing and tearing implements	Faith + craft
2. Protolithic	Natural stones	Hammers and grinders—hupfs and ahsts	Mechanical chance
B. Transitional	Cleft stones	Grinders and cutters	Chance + craft
3. Technolithic	Artificialized stones	Chipped, battered and polished implements	Designed shapement by molar action
C. Transitional	Malleable native metals	Copper celts, gold ornaments, etc.	Designed shapement by molar action + chance heating
4. Metallurgic	Smelted ores	Steel tools, etc.	Shapement by molar and molecular action

nection with this department, and in 1883 they submitted to the association their final report, from which is derived the following information. The variations in stature, weight, and complexion existing in different districts of the British isles appear to be chiefly due to differences of racial origin, and this influence predominates over all others. We have reason to believe, from historical and antiquarian researches, that the ancient Caledonii, the Belgæ, and Cimbri, and the Saxons and Frisians, as well as the Danes and Normans, were all people of great stature. On the other hand, the prehistoric (neolithic) race or races of Great Britain appear to have been of low or moderate stature. Accordingly the higher statures are found in the Pictish and Cimbro-British districts of Galloway; in the Anglo-Danish districts of North and East Yorkshire, Westmoreland, and Lincolnshire, and in Cumberland, whose people are ethnologically intermediate between the two. Lothian and Berwickshire are mainly Anglian, while the Perthshire Highlanders are the most clearly identified as the descendants of the Caledonii. Norfolk holds a high position in regard to stature, owing to a large admixture of Danish blood on the coast. There is a fringe of moderately high stature all round the coast from Norfolk to Cornwall, while the inland people, retaining more of the ancient British blood, yield lower averages. Middlesex and Hertfordshire, which stand very low, were later and less perfectly colonized by the Anglo-Saxons than the surrounding counties, and nearly the same may be said of the counties surrounding the Severn estuary and the Welsh border. Cornwall stands higher than the surrounding counties, and this is probably due to its having become the refuge of the military class of south Britain, in the main of Belgic origin. Flint and Denbigh owe their superiority to the other Welsh counties to the immigration of the Cumbrian and Strathclyde Britons. The inhabitants of the western provinces of Ireland possess a high stature similar to that found in the Scotch Highlands, with which they may have a common racial origin, while the lower stature of the eastern provinces is probably traceable to the comparatively recent Scotch and English immigrations. As to geographical distribution, the inhabitants of the more elevated districts possess a greater stature than those of alluvial plains. The counties forming the river valleys of the Severn and Wye, the Thames, the Dee, and Mersey, the Clyde, the Trent, and the fen district of Cambridge and Huntingdon, show a lower stature than the surrounding counties inhabited by persons of a similar racial origin. With respect to latitude and climate, the inhabitants of the northern and colder districts possess greater stature than those of the southern and warmer parts of the island; those of the northeastern and drier regions are taller than those of the southwestern and damper climates. A similar disposition of stature has been found to exist in France and Italy, the inhabitants of both these countries being taller in the northern than in the southern provinces. The same rule applies to the whole of the countries of Europe with respect to each other. Grouping the observations according to the place of birth in England, Wales, Scotland, and Ireland the general results may be summarized as follows: The Scotch male adults stand first in height (68.71 inches), the Irish second (67.90 inches), the English third (67.68 inches), and the Welsh last (66.66 inches). In weight the Scotch take the first place (165.3 pounds), the Welsh the second (158.3 pounds), the English the third (155.0 pounds), and the Irish the last (154.1 pounds). For each inch of stature a Scotchman weighs 2.406 pounds, a Welshman 2.375 pounds, an Englishman 2.301 pounds, and an Irishman 2.270 pounds. The chest-girth of the adult British male (the measurements being, however, mainly those of Englishmen) varies from 45 to 27 inches, the mean being 36 inches. The strength of the arms exerted as in drawing a bow ranges from 150 to 30 pounds, the mean being 70 pounds. The average height of adult females in England is 62.65 inches, being 4.71 inches less than the male average; the average weight of females is 122.8 pounds, being 32.2 pounds under that of the males. The females are stated to average little more than half the strength of males measured by straining the arms, but the observations were obtained from pupils in training schools for mistresses, and from shop assistants, so that the average is no doubt much lower than if the laboring classes had been included. The average height of the adult males of the principal races or nationalities of the world may be given as under; but more numerous measurements might alter some of the figures considerably: Polynesians, 69.33 inches; Patagonians, 69 inches; Negroes of the Congo, 69 inches; Scotch 68.71 inches; Iroquois Indians, 68.28 inches; Irish, 67.90 inches; United States (whites) 67.67 inches; English, 67.68 inches; Norwegians, 67.66 inches; Zulus, 67.19 inches; Welsh, 66.66 inches; Danes, 66.65 inches; Dutch, 66.62 inches; American negroes, 66.62 inches; Hungarians, 66.58 inches; Germans, 66.54 inches; Swiss, 66.43 inches; Belgians, 66.38 inches; French, 66.23 inches; Berbers, 66.10 inches; Arabs, 66.08 inches; Russians, 66.04 inches; Italians, 66 inches; Spaniards, 65.66 inches; Esquimaux, 65.10 inches; Papuans, 64.78 inches; Hindus, 64.76 inches; Chinese, 64.17 inches; Poles, 63.87 inches; Finns, 63.60 inches; Japanese, 63.11 inches; Peruvians, 63 inches; Malays, 62.34 inches; Lapps, 59.2 inches; Bosjesmans, 52.78 inches. The average stature of man is thus about 65.25 inches. With respect to the measurement of children at birth it is found that the average length of a British male infant is 19.52 inches, and of females 19.32 inches. The average naked weight of male infants is 7.12 pounds, of females 6.94 pounds. Growth is most rapid during the first five years of life, and during that period the rate of increase is about the same in both sexes, the gain being 21.51 inches. From 5 to 10 years boys grow a little more rapidly than girls, the male increase being 10.81 inches, the female 10.50 inches. From 10 to 15 years girls grow more rapidly than boys, and at the ages of 11½ to 14½ are actually taller, and from 12½ to 15½ actually heavier than boys. From 15 to 20 years boys again take the lead, and grow at first rapidly, then gradually slower, and complete their growth at about 23 years. After 15 girls grow very slowly, and attain their full stature about the 20th year. The strength of males increases rapidly from 12 to 19 years and at a rate simi-

ear to the weight; more slowly and regularly up to 30 years, after which it declines at an increasing rate to the age of 60. The strength of females increases at a more uniform rate from 9 to 19 years, more slowly to 30, after which it decreases in a manner similar to that of males.

An'thropomor'phism, a term expressing the representation or conception of Deity under a human form, or with human attributes and affections. Such a conception springs from the natural inaptitude of the human mind for conceiving spiritual things except through sensuous images, and in its consequent tendency to accept such expressions as those of Scripture when it speaks of the eye, the ear, and the hand of God, of his seeing and hearing, of his remembering and forgetting, of his making man in his own image, etc., in a too literal sense. The term is also applied to that doctrine which attributes to animals mental faculties of the same nature as those of man, though much lower in degree: strictly called biological anthropomorphism, to distinguish it from anthropomorphism proper, or theological anthropomorphism.

An'thropoph'agi, the name given to individuals or tribes by whom human flesh is eaten: man-eaters, cannibals. The Caribs are said to have been cannibals at the time of the Spanish conquest of America, and the word "cannibal" is derived from their name.

An'ti, or CAMPA, a warlike tribe of southern Peru on the eastern slope of the Andes. Their principal garment is a poncho belted at the waist. The men are workers in metal to a considerable extent, and the women are skilful weavers. They cultivate the ground, wild animals, tamed, serving as beasts of burden.

An'tia'rin, the poisonous principle found in the milky juice of the upas tree (*Antiaris toxicaria*) in Java. It has the probable formula $C_{14}H_{20}O_6 + 2H_2O$. The gum prepared from the upas juice is used by the natives of Java for poisoning arrows. Antiarin, when taken into the stomach or introduced into the circulation through a wound, causes great prostration, and, in sufficient quantity, paralysis of the heart.

Antibes, äṅ-tēb, a fortified town and seaport of France, on the Mediterranean, 11 miles south-southwest of Nice; founded about 340 B.C. by a colony of Greeks, who named it Antipolis. It has a naval school, and exports olives, anchovies, perfumery, etc. Pop. (1901), town, 5,512; commune, 10,947.

An'tibo'dy. See IMMUNITY.

Anti-Catholic Riots. See ORANGEMEN.

An'tichlor, ăn'tĭ-klōr (from *chlorine* and *anti*). In bleaching, any substance used to eliminate, by chemical means, the last traces of chlorine from a material that has been bleached by the action of a chlorine compound. The free chlorine can be largely removed by mere washing, but it cannot be entirely eliminated in this manner, and the residuum, if not removed by chemical means, is injurious to the material and causes it to disintegrate slowly. Sulphur dioxid was long used as an antichlor, its action being indicated by the following formula: $SO_2 + 2H_2O + 2Cl = H_2SO_4 + 2HCl$; that is, it combines with the chlorine to form sulphuric and hydrochloric acids. Sulphite of soda, Na_2SO_3, is equally effective, its action being as follows: $Na_2SO_3 + H_2O + 2Cl = Na_2SO_4 + 2HCl$. Sodium thiosulphate (better known in the arts as hyposulphite of soda, or "hypo,") is now more commonly used as an antichlor, since it is both cheaper and more efficacious. Its formula is $Na_2S_2O_3$, and its action is as follows: $Na_2S_2O_3 + 5H_2O + 8Cl = Na_2SO_4 + 8HCl + H_2SO_4$. (Sodium thiosulphate, water, and chlorine yield sodium sulphate, hydrochloric acid, and sulphuric acid.) In practice carbonate of soda is often added to the antichlor to neutralize the acids formed by the absorption of the chlorine. The resulting salts of soda are easily washed out of the material treated; and no damage results even if they are not entirely removed.

An'tichrist, a term of Biblical origin, but occurring only in the Epistles of John, where it signifies a person or persons who deny the Father and the Son and disown the incarnation and messiahship of Jesus. They are deceivers whose presence in the world betokens the last time. This writer seems to have in mind numerous false human teachers, originally members of, but always alien to the followers of Christ. He seems also to refer to some single arch-deceiver of whom all false teachers are exponents, and in whom is concentrated all antagonism of error and ill will to Christ and his kingdom of truth and grace. There are, however, other Biblical passages in which such antagonisms find acute and culminating expression, and it has been the custom of students to handle all these sections under the study of the Antichrist. Such passages are Matt. XXIV., with its allusions to false prophets and false Christs; 2 Thess. ii., with its "man of sin"; Rev. xi., xii., and xiii., with its dragon and beast; and Daniel vii. and viii., with its figures of the terrible beast and the he-goat. In all these passages a central feature is the mighty opponent and assailant of the people and purposes of God. Clustered about this central personified or personal antagonist of all worshippers of the true God numerous significant features continually recur. Such are names, times, places, forms. These features, variant in themselves, when differently combined by would-be interpreters, yield perplexingly manifold and divergent schemes, as the history of the theme abundantly displays.

The history of interpretation shows four names to have special eminence alongside the name Antichrist, thus: Dragon, Satan, Demon, Belial. The efforts to identify him cluster around typical views. Some deem him to be a form of Jewish antagonism to the Christian faith. Here he is traced to Capernaum, Chorazin, Bethsaida, or to Jerusalem. Frequently he is described as hostile to the Jews, being the counterfeit and foe of the Jewish Messiah. Very many identify him in some way with Rome, naming pre-eminently Nero, or a *Nero redivivus,* or Titus, or Caligula. Quite commonly in the Middle Ages he was seen in Mohammed or in the Turks. Still later some Catholics identified him with Luther. Many emphasized in the Antichrist, whatever his form, the energy or wisdom or very being of Satan or the Dragon. As to times, the diver-

sity of views falls into three classes. Many writers refer all the Biblical allusions to events current at the time of writing. Many others deem the reference to events still future. Still others hold the Biblical teachings to be pre-eminently predictive, but find their fulfilment partial and manifold throughout all Christian history, until their final consummation will mark the end. As to the place of his appearance or activity mention may be found of the Jewish Temple, Jerusalem, Mount of Olives, heaven itself. Closely connected with these central features are various attendant elements such as Michael, his great antagonist and victor; Gog and Magog and the nations which are his minions; the miracles which he works; the two witnesses, Enoch and Elijah, whom he slays; the sign of the Antichrist and the Son of Man; his world dominion; and his final doom. It is manifest that this theme presents a programme of thought and activity of most profound significance, however perplexing its solution. The persistence of its main elements through such a long train of history attests something vital in human life. But its outline is nowhere complete. In recent years the effort to solve its mystery and find its meaning has taken new form and course. Scholars are trying to trace every element of the Antichrist tradition to its historical source. The leaders here are Dieterich, who, in his ‹Abraxas› and ‹Nekyia,› traces parallelisms in Greek myths; Gunkel, who, in his ‹Schöpfung und Chaos,› attempts the same task in old Babylonian mythology; Bousset, who, in his ‹Der Antichrist,› explores post-Christian literature of all types for echoes of the tradition; and Friedländer, who, in his ‹Der Antichrist in den Vorchristlichen Jüdischen Zuellen,› tries to show that every essential trait of the Antichrist is traceable in Jewish circles before the destruction of the temple. The writer last named conceives the Babylonian dragon myth, the Hebrew sons of Belial, the foes of God and his Messiah in Ps. ii., the Zedim of Ps. cxix., the minim of various Jewish writings, the Belial of the Sybilline oracle, the Gnostics, the great antagonist of Daniel, the man of sin in 2 Thess. ii., the false Christ of Matt. xxiv., the Antichrist of John's Epistles, and the dragon of Rev. xi., to be all and severally various phases in one consistent development of the Antichrist idea. These studies, though but the early stages of a mighty task, disclose a commanding theme. For a history of the exposition of 2 Thess. ii. see Bornemann's ‹Commentary› in the Meyer series. For a thorough statement of the Nero speculations see De Wette's ‹Excursus› in his ‹Commentary on Rev. xvii.›; also R. H. Charles, ‹The Ascension of Isaiah,› § 17.

An'ticline, a geological term applied to an up-arching of strata into a fold from whose summit the beds dip outward on both sides. Such a fold resembles an ordinary roof whose sides correspond to the limbs of the fold, while the ridge represents the anticlinal axis. An anticline may be broad with its limbs lying almost flat, or it may be compressed and sharp,— sometimes the strata stand in vertical positions. The anticlinal axis is never perfectly horizontal, and while the fold frequently persists for a distance of several miles, it eventually dies out. The inclination of the axis is called the pitch of the fold. A complex anticline composed of several parallel folds is known as an anticlinorium. The anticline is the complement of the syncline (q.v.), in which the strata are bent into a trough with the axis at the bottom. Both types of folds are the characteristic features of mountain regions. See GEOLOGY; MOUNTAINS; STRATA.

An'ticos'ti, a barren island in the Gulf of St. Lawrence, 135 miles long and 40 miles at its greatest width. The hills in the interior rise to about 600 feet. The climate is severe; while the surface is an alternation of rocks and swamps. It is visited by fishermen in the summer, but there are few inhabitants save lighthouse keepers and official residents. The island, which is attached to the Canadian province of Quebec, has considerable salmon, trout, cod, and herring fisheries, and is a resort for seal- and bear-hunting. In 1895 the island was purchased by M. Henri Menier of France, who had much litigation over the rights of some settlers. A decision in his favor was made in 1900. Pop. 250.

An'ticy'clone, an atmospheric condition characterized by high barometric pressure and outblowing winds,— the opposite of cyclone. An anticyclone extends over a wide area and in the temperate zones usually appears in the west and moves eastward with slow velocity. At the centre of the area the winds move downward, thus bringing the cool, dry air of the upper regions into contact with the earth's surface. Anticyclones are generally accompanied by clear, pleasant weather, but when following a storm in winter they may result in cold waves. See METEOROLOGY.

Anticyra, ăn-tĭs'ĭ-ra, the name of three Grecian towns in Thessaly, Phocis, and Locris, famous for the hellebore which grew in their neighborhood. This plant was in high repute as a medicine, and was thought to have the effect of clearing the brain and curing stupidity; hence the expression of Horace, «*Naviget Anticyram*,» «Let him sail to Anticyra.»

An'tidotes. See POISONS.

An'tiemet'ic, a remedy employed to relieve nausea and vomiting. The choice of an antiemetic depends very largely on the nature of the cause of the nausea and vomiting. There are local antiemetics, acting solely on the mucous membrane of the pharynx, œsophagus, or stomach, and central antiemetics, acting on the nervous system. Among the best local remedies are cracked ice, cold beer, cold carbonated waters, cold champagne, small doses of tincture of iodine, chloroform, belladonna, cocaine, bromides, or chloral. The most reliable general antiemetics are ipecac, opium, and its alkaloids. See EMETICS.

Antietam, ăn-tē'tăm, **The Battle of,** fought on 17 Sept. 1862, in Maryland; sometimes called the battle of Sharpsburg. It was one of the decisive engagements of the Civil War, as it ended the first Confederate attempt at invasion of the North, though tactically a drawn battle. Lee's army of about 50,000 crossed the Potomac near Leesburg, some 30 miles above Washington, and concentrated around Frederick, about 40 miles from Washington and 20 from the Pennsylvania line. When it became known

that Lee had crossed into Maryland Gen. McClellan, in command of the Army of the Potomac, pushed forward several corps with the left on the Potomac.

Meanwhile Lee had ordered a movement on Harper's Ferry (q.v.), in his rear at the junction of the Potomac and Shenandoah. It was a valuable defense against invasion through the Valley of Virginia, but once the Confederates were across it became not only worthless but a trap. Nevertheless Gen. Halleck ordered it held; and Lee grasped the chance of capturing its defenders (with the Martinsburg outpost) and opening up his communications at once. This involved dividing his army for days, with a much superior force two or three days' march off, but he gauged his foes justly enough to take the risk. The operation was effected with great skill and success and accurate co-ordination; but it took longer than Lee expected, and a mischance befell which should have undone him. A copy of his order fell into McClellan's hands on the 13th, telling him of the dividing of that army not far off, its object, the position of the separate detachments, and the premium on expedition; but the opportunity was lost to the Federals through McClellan's unexplained delay in giving orders for an advance.

Lee, advised by the night of the 13th at Hagerstown that McClellan was advancing on South Mountain, marched back to resist his advance but was defeated and on night of 14th fell back to Sharpsburg, a few miles southwest of Boonsboro, as the nearest strong position for his Harper's Ferry detachments to rejoin him, as on the flank and rear of any force menacing Maryland Heights which they occupied, and a very defensible position in itself. Six or seven miles above the Heights the Potomac receives Antietam Creek, flowing through a ravine, with banks rising on the west to a low ridge having wooded patches, ledges, stone and wooden fences, cornfields, etc., as natural bulwarks, and sloping on the western side to the Potomac. Two and a half miles above the confluence a sharp eastern bend of the Potomac brings it within 2½ miles of the Antietam; and at about the centre of the peninsula thus formed lies Sharpsburg, in a hollow on the western slope. Lee's line, about three miles along the crest, was to rest one flank on an elevation near the Potomac, with the village in the rear centre, and a secure retreat by the Shepherdstown ford of the Potomac in the rear.

The Union troops having forced South Mountain (q.v.) by two sharp battles on the 14th, the main body issued therefrom next morning, marched the eight miles to Antietam Creek, and formed in line along the east ridge. By afternoon some 50,000 troops were opposed to about 30,000 under Lee, with Longstreet and D. H. Hill. Late in the afternoon McClellan came up, was received with immense enthusiasm, and decided that it was too late to attack that day. On the 16th Jackson and Walker had joined Lee with fully 10,000 more. The chance of splitting the Confederate army being now lost, McClellan waited for his ammunition and supply trains to arrive and ordered no attack save of Hooker's corps on the right late in the afternoon. A list of divisions and commanders now becomes requisite for brevity and intelligibility in describing the battle.

Union Army.

Right Wing.— Jos. Hooker. First Corps: Jos. Hooker; three divisions; commanders, Abner Doubleday, J. B. Ricketts, G. G. Meade.

Centre.— E. V. Sumner. Second Corps: E. V. Sumner; three divisions; commanders, I. B. Richardson, John Sedgwick, W. H. French. Twelfth Corps: J. K. F. Mansfield; two divisions; commanders, A. S. Williams, G. S. Greene.

Left Wing.— A. E. Burnside. Ninth Corps: J. D. Cox; four divisions; commanders, O. B. Willcox, S. D. Sturgis, I. P. Rodman, J. D. Cox (in the battle, E. P. Scammon). But Burnside refused to take personal command of the corps because, while he had previously commanded the right wing with the First and Ninth under him on the day previous, the former (Hooker's) had been taken from him and made an independent command; he feared that acquiescence would lose it to him permanently, and merely transmitted orders through Cox. The corps therefore had a technical commander who would not exercise initiative and a real one who could not.

Reserve.— Fifth Corps: Fitz-John Porter; two divisions; commanders, Geo. Morell, Geo. Sykes. Sixth Corps: Wm. B. Franklin; two divisions; commanders, H. W. Slocum, W. F. Smith. Temporarily attached, D. N. Couch's division from the Fourth Corps. This came from Pleasant Valley during the forenoon, and portions were used as reserves. Couch's division did not reach the field until after dark of 17th.

Cavalry.— Alfred Pleasonton.

Confederate Army.

First Corps.— Jas. Longstreet. Five divisions; commanders, Lafayette McLaws, R. H. Anderson, D. R. Jones, J. G. Walker, J. B. Hood.

Second Corps.—T. J. ("Stonewall") Jackson; four divisions; commanders, I. R. Jones A. R. Lawton, A. P. Hill, D. H. Hill.

Some crucial points of the battle-ground must be noted. The heart of the fighting was north and east of a Dunkard chapel of red brick, a mile north of Sharpsburg, on the west side of the Hagerstown turnpike, with tall woods free from underbrush to the west and north (the "west woods"), and elevated ground with ledges, hollows, etc., to the north (Nicodemus' Hill) and west. Next to and across the road was open ground, with a field of high strong corn opposite the north end of the west woods, and then the "east woods," also interspersed with rocks, with a commanding ridge running south, cut by a sunken road (the "Bloody Lane") running east from the turnpike.

On the morning of the 17th Fitzhugh Lee's cavalry brigade and some artillery formed the extreme Confederate left, holding Nicodemus' Hill; next Jackson, Jones' division, in and in front of the west woods, and the bulk of Ewell's division on Jones' right, in the open ground east of the Hagerstown turnpike; D. H. Hill on the left centre. Longstreet formed the centre and right, and A. P. Hill on the extreme right came up in the afternoon. Hood on the left was relieved by Ewell the night before, and formed a reserve near the Dunkard church. McLaws withdrew from Maryland Heights on the 15th and 16th, crossed and recrossed the

Potomac, and rejoined Lee early on the morning of the 17th, also taking post on the left.

On the Union side, Hooker having crossed the Antietam, Mansfield also crossed in the night and took position in the rear. Sumner and Burnside remained east of the stream. The Confederates rightly inferred from the Union dispositions that the force of the attack was to be on their left, and strengthened it accordingly: 10 of the best brigades in their army were placed in the west and east woods and south of the cornfield. They had nearly 40,000 men in the battle; the Union troops engaged numbered about 55,000. This superiority was little enough against the immense advantages of the Confederate position; and even so, it was frittered away in a series of disconnected attacks, which left a large part of the Confederate force usable at one time against 15,000 Federal troops at most.

1. Hooker, lying nearly a mile north of the Dunkard church, moved down against Jackson early in the morning; reported strength 14,856; actual, under 10,000. The objective point was the elevated ground about the church. The march had its right on the turnpike and its left along the west edge of the east woods, from which a withering fire checked it a little; the right was raked by a flanking fire from the west woods. At length the line gained the southern edge of the cornfield and engaged the Confederates in the open ground about 220 yards distant. Under the storm of bullets, shot, and shell that rained upon them, they broke and fled through the corn, to re-form in a hollow beyond; the Confederates assailed the Union lines in turn, and in turn were riddled by a concentrated fire that drove them back. Again the Union troops advanced, to be forced back in disorder; and again the Confederates followed, to break and fly. This was one of the most frightful carnages of the Civil War: Jackson's famous "Stonewall" division was nearly annihilated, more than half of two brigades killed or wounded and more than a third of another, and all the regimental commanders but two. On the Union side 1,051 in Rickett's division were cut down, a third of its whole number, and two brigades lost over 40 per cent; Hooker was wounded and was succeeded by Meade. Hood and D. H. Hill now came up to replace Jackson's losses; and Hooker's remnants slowly withdrew northward just as the advance of the Twelfth came up, though Ricketts still held the edge of the east wood.

2. Mansfield was mortally wounded while deploying his troops about 7 A.M., and A. S. Williams took command: reported strength, 10,126; actual, about 7,000. Marching more obliquely to the road, facing southwest, they cleared the cornfield, and about 8.40 A.M. drove the Confederates across the turnpike and into the west woods.

3. The Second Corps, under Sumner, had not received orders to march till 7.20, after the First was crippled and the Twelfth in the thick of action; and Richardson's waiting for Morell's division of the Fifth corps to occupy the ground he vacated caused him to be an hour later still. Sedgwick's division, with Sumner at the head, went first, French following; each with perhaps 5,000 men; they crossed the Antietam, moving west by north, till the centre was nearly opposite the Dunkard church; then deploying, faced west, French forming on Greene's left. Sedgwick passed through the east woods and the cornfield; advanced swiftly in three lines, no regiments in column or ready to face to either flank if attacked, swept by Greene's right and pressed through the west woods with left on the church, to the western edge and a wood road along it. Meantime McLaws and Walker with six brigades had come up, one brigade had been drawn from the right to reinforce Early's forces of Ewell's division; and all fell upon Sedgwick's left flank and rear. Nearly 2,000 Union soldiers were struck down at a blow without a chance to retaliate; this division lost 2,255 men in all, more than 40 per cent of its entire number, including Sedgwick severely wounded. Sumner tried to change front, but the lines broke and scattered northward, sweeping away everything in their rush, and only re-formed on the north hill where Meade and the First corps had taken refuge. A brigade of the Twelfth came up to help, but lost a third of its number, one regiment losing 60 per cent. The right of the Confederate attacking line crossed the turnpike at the Dunkard church and made two assaults upon Greene's position east of the church, and were repulsed with great slaughter, and Greene, making a counter charge, entered the woods beyond the church. Greene held this position until noon, when the Confederates attacked both his flanks and drove him from the church.

Meantime W. F. Smith of Franklin's corps had come on the field. Hancock (then one of his brigadiers) obtained a regiment from Sumner, took position opposite the woods, drove away the approaching Confederate skirmishers, and silenced their batteries. A second brigade was placed on his left, and with heavy loss advanced to near the church; but on sending for his reserve brigade to support it he found it had been ordered away to support French. The latter moving to the left south of the east woods, over the farm lands, drove back D. H. Hill's skirmishers to his main line in the sunken road, where he engaged him over an hour, when he was joined by Richardson. Here a long and sanguinary conflict ensued: the Confederates turned the "Bloody Lane" into a rough fortress with fence rails, and before carrying it the Union divisions had lost near a third of their total, one regiment losing 60 per cent. They had won the position by perhaps 1 P.M., and shortly afterward French's troops were relieved by a brigade of Smith's division. Richardson withdrew his men to the ridge, and about that time was mortally wounded and succeeded by Hancock. This practically ended the operations on the Federal right, and indeed the battle of Antietam so far as it had any tendency to change the *status quo*. When Richardson's line had been withdrawn, there was a vigorous contest of artillery. Meagher's brigade took the centre, and somewhat less than two regiments came from French to aid Richardson's division. Despite the application for artillery for the division, none had been obtained. The length of the Union line made it impossible that more than one line of troops be formed; and so far advanced was this line that a part of it was continually swept by the fire of the batteries on the Confederate left, these batteries being protected by the west woods. An attack on the Union left was successfully repulsed by Hexamer's battery (obtained from Franklin) and Battery I, First artillery.

4. Between 4 and 5 P.M. a regiment of Franklin's corps was ordered to drive away some skirmishers of Hill's division south of the Bloody Lane and succeeded at the cost of half its force.

5. The battle which Franklin was not allowed to fight must be mentioned. It has been noted that Smith's action was paralyzed by taking away a third of his force for service elsewhere. About noon Slocum, with the other division, reached the field, and two brigades were at once formed in line to carry the woods around the church; but again the reserve brigade was ordered off. Franklin urged with all his strength to have a grand assault made with his whole corps on Lee's centre, crippled and worn out with half a day's fighting and slaughter. With relatively fresh troops, and French and Richardson to aid, it is most probable that few Confederates would have crossed into Shepherdstown. But Sumner refused to permit the movement; still, Franklin was so urgent that he referred the decision to McClellan, but with so strong a veto that McClellan deferred to him and sanctioned the refusal. Both credited Lee with double or treble his actual numbers, and considered the terrible resistance, not as a proof that it could not be continued, but that any force which assailed him went to destruction. This refusal forms another of the might-have-beens of the battle, with some peculiarly poignant personal tragedy involved.

6. The action of the left under Burnside is an even more acute personal question. His peculiar position has already been noted. About 7 A.M. he received an order to hold himself in readiness to carry by assault a stone ridge across the Antietam about a mile southeast of Sharpsburg. About 10, when the First and Twelfth Corps and Sedgwick's division were out of the fight, he received another order to carry the bridge and the heights beyond, and advance on the rear of Sharpsburg. He turned it over to Cox, who ordered a brigade to storm the bridge, Rodman to cross by a ford one third of a mile below, and the two to carry the heights and unite there. At best this could not be done in a moment, and the movement seems a covering rather than an aggressive one. But Crook missed the bridge and could not get back to it under fire: Rodman missed the ford and was two hours or so crossing under fire; a fresh storming party finally carried the bridge, Crook crossed some companies above and others at the bridge, and Rodman and the rest united about 1 P.M., when the battle on the right was virtually over. Meantime Sturgis' division had run out of ammunition and was reported unfit for duty; it was replaced by Willcox's (Burnside assisted in this), and at 3 P.M. the corps was again ready to move, though much damaged by the constant Confederate artillery fire. The right wing broke Jones' division and gained the suburbs of Sharpsburg; but the left was strongly checked, and the two wings grew widely separated. Meantime A. P. Hill came upon the field, having marched 17 miles in seven hours. He took Rodman's division in its undefended flank (the second misadventure of the sort that day), and Rodman was killed, while a concentric fire mowed down his men. The losses of the corps were 2,349; a fearful total, almost exactly those of Sedgwick's division. A panic was averted by Scammon, who changed front and checked Hill for a little; Cox called up Sturgis and made head for a while: but at length the corps was obliged to withdraw to the cover of the hills that border the Antietam.

The Union losses were 12,410: 2,108 killed, 9,549 wounded, and 753 missing. More men were killed on this one day than on any other of the Civil War. The Confederate losses were never known with exactness; but as 2,700 of their dead were counted and buried by the Union forces, and many had previously been buried by their comrades, the total cannot have been less than the Federal. The next day Lee retreated across the Potomac unopposed: the failure to pursue him was one of the grievances against McClellan later, but most of his generals concurred with him. Although Lee had escaped destruction, he had none the less failed in his campaign.

(The Count of Paris' 'History of the Civil War,' Vol. II., 1876, is from the standpoint of a strong admirer of McClellan, whose staff he was on; F. W. Palfrey's 'The Antietam and Fredericksburg,' 1882, from a lieutenant-colonel of Sedgwick's division, is sharply critical of nearly all the Union generals; John C. Ropes' 'Story of the Civil War,' Vol. I., 1894, is from a noted military critic; Michie's 'General McClellan,' 1901, is from a distinguished engineer officer and professor at West Point; the account in 'Battles and Leaders of the Civil War' (N. Y. 1884-8), is by Gen. J. D. Cox. Consult also, 'McClellan's Own Story' (1866), and Lives of Gen. McClellan and the general officers.)

FORREST MORGAN,
Connecticut Historical Society.

An'tifeb'rin, a trade name for the substance known to chemists as acetanilide (q.v.).

An'ti-Fed'eralists, the first political party in the United States after the separation from Great Britain. The loyalists having been expelled, there was no issue to divide upon till the question of replacing the loose Confederation with a stronger bond came up. The representatives of commerce and capital, and the mass of the educated classes, favored ratifying the Constitution; those who feared that a strong government meant a disguised new kingship, the local leaders who wished to retain pre-eminence, and the conservatives who thought no evils comparable to those of change, opposed it. The names were in direct opposition to the facts, the Federalists striving to turn the federation into a unified nation, the Anti-Federalists endeavoring to preserve a loose disintegrated federation. The victory of the superior classes was overwhelming, one great cause being that the men who were later the leaders of the Anti-Federal opposition were Federalists (q.v.) for the time being, as they felt that the existing condition of affairs was intolerable. In the organization of the first Congress and executive under the Constitution, the Federalists proper held every post but three, and even those were not technically «anti» till later. In this Congress, though there was much individual opposition to the Federalist measures, it was unorganized, and the Anti-Federal spirit could hardly be said to animate a body. Hamilton's scheme for clearing up the public debt was the first point of division. The payment of foreign debts was carried unanimously; that

for paying the Continental debt at par was opposed by Madison and others except as to original holders; that for assuming the State debts was bitterly fought as defaming the States' solvency and as buying the support of capital for the Federal government, was carried by only five votes, reconsidered and beaten by the seven votes of the new North Carolina just admitted, again reconsidered and carried by Jefferson's log-roll of establishing the new capital on the Potomac. His national-bank scheme (1791, opposed by Madison in the House and Jefferson and Randolph in the Cabinet) and his tariff and excise schemes also excited a growing hostility from this element, which by the time of the 2d Congress (1 Oct. 1791) was becoming a new strict-construction party; no longer opposed to the Constitution as such, but opposed to extending its powers beyond the most literal interpretation of its terms. Jefferson, Madison, and Randolph were now the chiefs of the new party in public office; but Jefferson disclaimed being an Anti-Federalist, based his policy on love of «republicanism,» as sympathizing with the French revolution, and called the Hamiltonians «monarchists.» The Republicans and Anti-Federalists comprised the same elements, however, and were based on the same natural division, and Washington's proclamation of neutrality in the European conflict in 1793 fused them into one as the Republicans, later into the Democratic-Republican party.

Antigo, Wis., county-seat of Langlade County, a northern county of the State. It is situated in the southwestern portion of the county, 96 miles north-northwest of Oshkosh and 207 miles northwest of Milwaukee; and it is on the Spring Brook River and the Chicago and Northwestern railway. It is the commercial centre of an agricultural section of considerable importance, and of a timber region which has contributed largely to Wisconsin's position in marketed forest products. There are located several extensive manufactures of various sorts, including chair, hub, broom-handle, excelsior, veneer, and other factories; also foundries, breweries, railway-shops, and flour, planing, and saw mills. Antigo was settled about 1878, and in 1884 was incorporated. Under the provisions of a general law of Wisconsin, its government is administered by a mayor, elected for a two-years' term, and a municipal council. Pop. (1890) 4,424; (1900) 5,145.

Antigua, antē'gwa, one of the British West Indian islands, situated lat. 17° 6′ N. and lon. 61° 45′ W., about 50 miles east of Saint Kitts and the same distance north of Guadeloupe; area 108 square miles; dependencies Barbuda and Redonda, which have an area of 62 square miles; population including those dependencies 34,971 (mainly negroes) in 1901, as compared with 36,819 in 1891; the principal island of the Leeward group; residence of governor and his staff; port and chief town, Saint John; the chief products, sugar and pineapples. See ANTILLES; WEST INDIES.

Antilles, ăn-tĭl'lēz, the name given both to the group of large islands forming the northern limit and the chain of small islands forming the eastern border of the Caribbean Sea. Practically all of the West Indian Islands except the Bahamas are thus included. The Greater Antilles (Cuba, Jamaica, Haiti, and Porto Rico) have about 3,700,000 inhabitants, or nearly three fourths of the entire population of the West Indies. The Lesser Antilles extend toward the southeast in a curved line from Porto Rico to the coast of Venezuela and follow the line to that coast from the Orinoco delta westward to the Gulf of Maracaibo. Their total area is 5,557 square miles, and their population is approximately 1,230,000.

The following classification shows the natural grouping of the Lesser Antilles, with the area (in square miles) and the population of the islands in each of the groups:

1. *Virgin Islands.*— St. Croix (A. 74, pop. 18,430); St. John (A. 21, pop. 950); St. Thomas (A. 23, pop. 32,786); Tortola (A. 58, pop. 5,000); Anegada (A. 20); Virgin Gorda (A. 176). 2. *Outer Chain of Caribbee Islands.*— Anguilla (A. 35, pop. 3,699); St. Martin (A. 38, pop. 3,724); St. Bartholomew (A. 5, pop. 2,650); Barbuda (A. 62, pop. 639); Antigua (A. 108, pop. 34,971); Désirade (A. 10, pop. 1,400); Maria Calante (A. 65, pop. 13,850). 3. *Inner Chain of Caribbee Islands.*— Santa Cruz (A. 74, pop. 18,430); Saba (A. 5, pop. 2,065); St. Eustatius (A. 8, pop. 1,613); St. Christopher (A. 65, pop. 30,867); Nevis (A. 70, pop. 13,087); Montserrat (A. 32, pop. 11,762); Guadeloupe and dependencies (A. 600, pop. 167,000); Dominica (A. 290, pop. 26,841); Martinique (A. 400, pop. before volcanic eruption of 1902, about 187,000); St. Lucia (A. 245, pop. 46,671); St. Vincent (A. 131, pop. 41,054); Grenada (A. 133, pop. 54,000). 4. *Barbados.*—(A. 166, pop. 189,000). 5. *South American Islands.*— Tobago (A. 114, pop. 20,463); Trinidad (A. 1,754, pop. 248,804); Buen Ayre (A. 95, pop. 4,399); Curaçao (A. 210, pop. 28,187); smaller islands (A. 470, pop. 40,000).

English geographers call the northern part of the chain of Lesser Antilles «The Leeward Islands,» the capital of the Leeward government being on Antigua, and the southern half «The Windward Islands,» Grenada being headquarters of the Windward government. The present holdings of England, France, Denmark, and Holland in the Lesser Antilles are reminders of the early struggles of the European nations to win supremacy in the New World; for the West Indies were commonly regarded up to the end of the eighteenth century as the most valuable part of America, and these islands were the chief battle-ground of the rival powers. Admiral Rodney's victory over the French admiral De Grasse, 12 April 1782, gave England her commanding position in this region. Her possessions constituting several distinct colonial governments, include the Virgin group (except the Danish Islands, St. Thomas, St. Croix, and St. John); all below the centre of the chain, namely, St. Lucia, St. Vincent, Barbados, Grenada, Tobago, and Trinidad; the important island of Dominica, etc. The Virgin Islands are important because they command the deep-water Anegada passage between the Atlantic Ocean and the Caribbean Sea; and the only deep harbors (except St. Thomas) in the Lesser Antilles are in Trinidad and St. Lucia. The French retain among their possessions the somewhat larger islands of Guadeloupe and Martinique in the centre of the chain. The Dutch, in addition to Curaçao and Buen Ayre,

have a few small islands below the Anegada Passage, the whole width of the Caribbean Sea intervening. The economic history of the islands of the Lesser Antilles is simple. Nearly all of them derived their wealth in the past from sugar culture, and with the decline in the price of sugar have sunk into poverty. Meanwhile, the black population has crowded out the Caucasians.

MARRION WILCOX,
Authority on Latin-America.

An'ti-ma'sonry, in United States history, (1) the widespread hostility to the Freemasons, as an order whose oaths were contrary and superior to public duty and private morality, excited by the fate of William Morgan (q.v.) in 1826. He was a broken Virginian, who had settled in Batavia, N. Y., about 1824, as a mason by trade, and professing to be a Royal Arch Mason; and in the summer of 1826 was reported to be writing a book to expose the secrets of Freemasonry, to be printed at a local newspaper office. Though the Masons were naturally indignant and distressed, the other citizens regarded it as a catchpenny scheme, and had Morgan remained in view probably Masonry would have suffered little damage,— certainly none if the Masons had merely denied his statements, for his word would have carried no weight. But, unluckily, just at this time suits against him for debt began suddenly to multiply, and bail was either refused or disregarded. Finally on 11 August he was taken to Canandaigua, 50 miles away, on a charge of theft; was released, but at once rearrested for debt; and on the next night, being again released, he was at once seized and never reappeared. The public at once connected this with the Masonic exposure and threats, and vigilance committees were shortly organized which traced him beyond question, in the hands of abducting parties, to Fort Niagara, an unoccupied United States post at the mouth of the Niagara River; the last ever certainly known of him, though other statements made it seem probable that he had been murdered and thrown into Lake Ontario. The excitement, increased by the belief that prominent Masons obstructed the investigations, was fanned into flame by the appearance, a few weeks later, of the first part of Morgan's book, the other parts ultimately being published also; entitled 'Illustrations of Freemasonry, by One of the Fraternity Who Has Devoted Thirty Years to the Subject'; reprinted under various titles, as 'Light on Masonry,' 'Freemasonry Exposed and Explained,' etc. Along with a mass of dreary "ritual" for "working the degrees," of no moment even if true, and its betrayal a scandalous violation of good faith, it included some passages which if true would have obligated him to make them known at once on joining: such as an oath requiring Masons to place their duty to a brother Mason before their oaths in court; and others pronouncing dire vengeance (graduated according to the degree thus betrayed) on Masons who should reveal the secrets of the order, and obligating every "brother" to make it his business to execute the threat. The denials of the Masons were not thought categorical enough. The alleged agents in the abduction were put on trial between January 1827 and 1830, and several were convicted and sentenced, some pleading guilty to save examination as to conspiracy. They could not be held for murder, but popular judgment charged that crime to the fraternity if not to the individuals. Very soon Anti-Masonry had become the one issue of the day. Candidates for local office who refused to withdraw from the order were heavily "scratched" at elections, and great numbers of lodges had to give up their charters and dissolve. From New York the feeling spread through the Union, and more than 3,000 lodges surrendered their charters before the storm blew over. The governor of New York and a large number of the leading officials and prominent public men were Masons, as now; but in the campaign of 1828 the National Republicans dared not nominate any who belonged to the order. None the less the Anti-Masons formed a regular party, holding a convention at Utica and nominating Solomon Southwick for governor. Wm. H. Seward, Millard Fillmore, and Thurlow Weed first came forward as Anti-Masonic candidates. A body was conveniently found in Niagara River and said to be Morgan's, though of course unrecognizable; and Weed is credited with having replied, when questioned as to its authenticity, that it was "a good enough Morgan till after election." The ticket polled 33,345 votes out of 276,583; but it polled some 70,000 in 1829 and 128,000 in 1830, gradually absorbed the National Republican party in the State, and became the chief anti-Democratic organization. This is the most singular feature of the whole movement; for the National Republicans, like the Whigs and Republicans later, were distinctly the party of the upper business and professional classes, which were the very ones who formed the strength of the Masons. Yet the same result obtained everywhere: doubtless it was due to the accidental fact that Jackson, the idol of the Democracy and then President, was a Mason. A national convention was held in 1830 to organize a national party; and in September 1831, in order to force Clay, who was a Mason, out of the field, it held a convention (in Baltimore) before any of the other parties, and nominated William Wirt of Maryland and Amos Ellmaker of Pennsylvania for the Presidency. The National Republicans, however, supported Clay, and in the election of 1832 Wirt received only the electoral vote of Vermont. The party took no further national action, and with the National Republicans was soon absorbed in the new Whig party, though it retained force enough to compel the Whigs to discard Clay for Harrison in 1833 and 1839. In Pennsylvania, however, allied with the Whigs, it survived till about 1840 and elected a governor, Joseph Ritner. (2) Another Anti-Masonic body was formed in 1868 as the National Christian Association, at Pittsburg, Pa., though hostility to Masonry was only one of its tenets; it renamed itself in 1875 the American Party (q.v., No. 2), and entered politics. It opposed Freemasonry as "false religion and false politics," and urged the prohibition of oath-bound lodges as acknowledging another government than that of the United States.

Bibliography.— For Morgan, see Morris, 'History of the Morgan Affair' (1852); Greene, 'The Broken Seal, or the Morgan Abduction and Murder' (1870). For political results see Hammond, 'Political History of New York'; Hopkins, 'Political Parties' (1900).

An'ti-Mission Baptists (their own title is "Old School Baptists"), an American sect founded about 1835, who do not believe in Sunday-schools or theological seminaries, holding that salvation does not depend upon human instrumentalities, but upon divine grace alone.

Antimonan, ăn'te-mō-năn', a seaport town of Luzon, Philippine Islands, province of Tayabas. It is situated on Lamon Bay, about 100 miles southeast of Manila. Pop. about 11,000.

An'ti-Monop'oly Party, an American political organization which in 1884 nominated for the Presidency Benjamin F. Butler (q.v.), on a platform advocating election of United States senators by popular vote, an income tax, the repeal of all tariffs, and the prohibition of land grants to corporations. It united with the Greenback Labor party, the combined vote reaching 130,000 votes in the November election of 1884.

An'timony, the name of one of the metallic elements. It is found in nature in the metallic state, but its chief commercial source is the mineral stibnite, which is a sulphide of antimony (Sb_2S_3). Stibnite was known in very early times. It has been used by the women of the East for many centuries for painting the eyebrows and eyelashes and giving lustre to the eyes. Before the discovery of the metal itself, stibnite was called "antimony," and it appears that the paint used by Jezebel (2 Kings ix. 30) was finely ground stibnite. The Arabs called this face-paint *al-Koh'l* (compare ALCOHOL). The origin of the word "antimony" is not known. There is a legend that certain monks were once poisoned by it, and that the name is derived from *anti*, "against," and *moine*, "a monk"; so that *antimoine*, or antimony, would mean "monk's bane," or something of that sort. This derivation, however, is entirely fanciful. The first distinct mention of the metal itself is made by Basil Valentine, who gives a process for extracting it from stibnite, though he does not claim to have discovered it. Several methods for extracting it are now in use, chief of which is the following: Two parts of stibnite are melted with one part of thin scrap iron, in plumbago crucibles. Leaving the antimony the sulphur combines with the iron, so that sulphide of iron and metallic antimony result, the iron sulphide floating as a slag. The crude antimony so obtained is next melted with a small amount of sulphate of soda and a little of the slag obtained from the operation next to be described. By this means the metal is purified somewhat. It is then cast into molds, and when cold is broken up into small pieces, to prepare it for the third operation, which is called "melting for star metal." This last-named process consists in melting 60 parts of the broken metal with two parts of pearlash and five parts of slag from a previous operation of the same kind. The resulting metal or regulus is poured into square molds, into which some slag has first been allowed to run, and is cooled slowly while still covered with slag. If the metal is of good quality, the resulting blocks will have a stellated or crystalline surface. The total consumption of the metal is probably as much as 4,000 tons per annum, nearly all of which is smelted and refined in England. Ores of antimony occur in Mexico, California, Nevada, New Brunswick, France, Australia, Japan, China, Italy, Spain, Portugal, Corsica, and many other parts of the world.

Antimony is a brilliant, bluish-white, brittle, crystalline metal, with a specific gravity varying from 6.72 to 6.86. It melts at about 800° F., and if protected from the air boils at a white heat. At ordinary temperatures it is not acted upon by air or water, but it oxidizes quickly when melted, and at a red heat burns at a brilliant white flame, and can decompose water. It expands upon solidifying, and imparts this property to its commoner alloys. Its co-efficient of expansion is about .0000064 per degree F. The tensile strength of cast antimony is about 1,000 pounds per square inch of sectional area. It is a comparatively poor conductor of heat and electricity, its thermal conductivity being only about one twenty-fifth of that of silver; its electrical resistance is 0.488 of that of mercury at 32° F., and 0.704 that of mercury at 212° F. Its chemical symbol is Sb (from the Latin word ***stibium***), and its atomic weight is sensibly 120. It is diamagnetic; that is, a sphere made from it is repelled by a magnet, though the repulsion is hardly comparable in magnitude with the force of attraction that a magnet exerts upon iron. It also has marked thermo-electric properties, and is used in the laboratory in the construction of thermopiles. Antimony forms valuable alloys with other metals, and this is its most important use in the arts. Type metal is an alloy of lead, antimony, and tin, with sometimes a little copper. The tin adds toughness, while the antimony gives hardness and causes the alloy to expand upon solidifying, giving an accurate cast of the letter.

An'timony-pois'oning, a variety of poisoning formerly more common than at present. The mortality is about 40 per cent. The symptoms of acute poisoning resemble closely those of arsenic-poisoning. There is sudden acute gastric pain, with nausea and vomiting, pressure in the breast, and intense sense of anxiety. This is followed by colicky pains and diarrhœa. The pulse becomes small and frequent, later retarded; the respirations diminish in number, the skin is cyanotic, the temperature sinks, and coma and convulsions lead to death. If vomiting develops early, before time has elapsed to permit of the absorption of a large amount of the antimony salt, death is less likely to occur. The treatment should include washing out the stomach, inducing of vomiting, and the use of tannic acid compounds.

Anti-Nebraska Party. See KANSAS-NEBRASKA BILL.

An'tino'mianism, the name applied to the doctrine that the dispensation of grace as set forth in the New Testament frees the Christian from the claims and obligations of the moral law as presented in the Old Testament. In the early Church there were antinomian tendencies due to an over-emphasis of faith in opposition to works. This is especially so in some of the Gnostic systems, where faith and love are so emphasized that moral matters appear indifferent, and the contradictions between the law and the gospel are regarded as irreconcilable. Antinomianism marked many of the mediæval sects, but reached its fullest development in the

Reformation period. In Luther's emphasis on the doctrine of justification by faith he had used expressions which might be understood to indicate opposition between the law of Moses and the gospel, as though with the establishment of the gospel the law of Moses was no longer of any value. But when Luther carefully expressed himself on this point, as he did in his instruction to the Saxon preachers in 1527, he gave to the teachings of the Old Testament their proper place in the Christian life. This was disputed by Agricola, and a controversy broke out between him and Luther, in which he treated Luther's most extreme statements in regard to faith as though they were to be taken literally. His follower Amsdorf went as far as to say that good works were detrimental to salvation. In England there were Antinomians in the various sects in the time of Cromwell. They were high Calvinists and claimed that, as the elect cannot fall from grace, any act performed by them, however sinful it may seem to men, is not in reality sinful.

An'tioch (Latin, *Antiochia*), the ancient capital of the Greek kings of Syria; on the Orontes; about 21 miles from the sea. It was founded by Seleucus Nicator in 300 B.C., and named after his father Antiochus. The first inhabitants were brought from Antigonia, founded by Antigonus in 307. It was famed for the splendor of its public buildings, the Seleucid monarchs having vied with each other in embellishing their metropolis, and the Roman emperors having also done much to adorn it. It was called the "Queen of the East" and "The Beautiful," and was advantageously situated for trade, being easily approached by the caravans of the East, and through its port Seleucia having maritime communication with the West. The city is frequently mentioned in the New Testament, and it was here that the disciples of our Saviour were first called Christians (Acts xi. 26). In 64 B.C., on the breaking up of the kingdom of Syria, it was captured by Pompey; in 266 was captured by the Persians under Sapor; and in 538 was thrown into a heap of ruins by Persians under Chosroes. It was restored by the emperor Justinian, but never quite recovered from this last blow. In the first half of the 7th century it was taken by the Saracens and remained in their possession for upward of 300 years, when it was recovered by the Greek emperor Nicephorus Phocas. In 1098 it was taken by the Crusaders. They established the principality of Antioch, which lasted till 1268, when it was taken by the Mameluke sultan of Egypt. In 1516 it passed into the hands of the Turks. The modern Antioch or Antakieh is a poor place. It has some manufactures of silk stuffs, leather, and carpets, and has some trade in these articles and in goat's wool, beeswax, etc. The population is not far from 20,000.

Antioch College, an American coeducational institution in Yellow Springs, Ohio, founded in 1852 with Horace Mann as its first president. It has an endowment of over $100,000; its grounds and buildings are valued at $250,000; and its library contains 7,000 volumes. In 1901 it had 16 instructors and 177 students, its graduates numbering 2,260.

Anti'ochus, the name of 13 kings of Syria: 1. ANTIOCHUS I., or Antiochus Soter, son of Seleucus: b. about 324 B.C.; d. 261 B.C. He succeeded his father in 280 B.C. and disputed Macedonia with Antigonus Gonatas, but finally relinquished it to him. During the greater part of his reign he was engaged in a protracted struggle with the Gauls, by whom he was killed in battle. 2. ANTIOCHUS II., or ANTIOCHUS THEOS, who succeeded his father Antiochus I. Weakened by war with Egypt, he lost Parthia and Bactria by revolt. He was murdered in 246 B.C. by Laodice, his wife, whom he had put away to marry Berenice, daughter of Ptolemy. 3. ANTIOCHUS III., THE GREAT, grandson of Antiochus II., who succeeded his father Seleucus Callinicus in 223 B.C. at the age of 15. He made war on Parthia and Bactria, but was compelled, after a long war, to recognize the independence of these kingdoms. He next invaded India, where he remained for seven years (212–205 B.C.). Invading Asia Minor and crossing to Europe he took possession of the Thracian Chersonese. Antiochus gained an important ally in Hannibal, who had fled for refuge to his court; but lost the opportunity of an invasion of Italy while the Romans were engaged in war with the Gauls, of which the Carthaginian urged him to avail himself. In 192, at the request of the Ætolians, he crossed to Greece, but was defeated by the consul Acilius Glabrio and returned to Asia. He was defeated by Scipio near Magnesia, 190 B.C. Peace was granted him in 188 B.C. on the cession of all his dominions west of Mount Taurus, with a heavy indemnity. He also engaged to surrender refugees of his court, but he allowed Hannibal to escape. He was killed while plundering a temple in Elymais. 4. ANTIOCHUS IV., EPIPHANES, son of Antiochus the Great; d. 164 B.C. He is chiefly remarkable for his attempt to extirpate the Jewish religion. 5. ANTIOCHUS V., EUPATOR, son of Antiochus IV., who reigned from 164 B.C. to 162 B.C. 6. ANTIOCHUS VI., THEOS, ruled for three years, 145–142 B.C. 7. ANTIOCHUS VII., SIDETES, the son of Demetrius I.: b. about 164 B.C.; d. 129 B.C. He defeated the Parthians in several battles. 8. ANTIOCHUS VIII., GRYPUS, son of Demetrius II. He ruled 125–113 B.C. and 111–96 B.C. and was slain by Heracleon in the last named year. 9. ANTIOCHUS IX., CYZICENUS, son of Antiochus VII. Defeated in battle against Seleucus V., he committed suicide in 95 B.C. 10. ANTIOCHUS X., EUSEBES, son of Antiochus IX. He reigned but three years and was obliged to flee to Parthia in 92 B.C. 11. ANTIOCHUS XI., EPIPHANES, son of Antiochus Grypus. He reigned 95–93 B.C. and was drowned in the Orontes. 12. ANTIOCHUS XII., DIONYSUS, 85 B.C. He was killed in battle with the Nabatoreans. 13. ANTIOCHUS XIII., ASIATICUS, the son of Antiochus X., and the twentieth of the Seleucidian dynasty. Beginning his reign in 69 B.C. he was deposed by Pompey in 65 B.C.

Antiphlogis'tic, a term applied to medicines or methods of treatment that are intended to counteract inflammation, such as bloodletting, purgatives, diaphoretics, etc.

Antiph'ony ("alternate song"), a term denoting in the services of the Christian Church, a psalm, chant, or other composition, sung by

two parties in alternation, as by two choirs or parts of a choir, or first by a single voice and then repeated by the whole choir. The Roman Church applies the term antiphony in a restricted sense to a series of "words or verses prefixed to and following a psalm or psalms, to express in brief the mystery which the Church is contemplating in that part of her office." The practice of alternate singing formed a part of the old Jewish worship. Its introduction into the Christian Church is ascribed to Ignatius in the first century after Christ. The Western Church is said to have received it more particularly from St. Ambrose.

Antipodes, ăn-tĭp'ō-dēz (from the Greek *anti*, against, and *pous*, a foot), the name given to inhabitants of the earth diametrically opposite to each other, and of course literally applied to those who turn their feet toward each other; or to any part of the earth's surface situated diametrically opposite any given part. The antipodes live in similar and, except at the equator, opposite latitudes, and their longitudes differ by 180°. Hence the difference in their time is about 12 hours, and their seasons are reversed. The spherical form of the earth naturally leads us to the idea of the antipodes, of whose existence some idea was entertained even before the age of Cicero.

Antipodes Island, ăn-tĭp'ō-dēz is'land, a small uninhabited island in the South Pacific Ocean, about 460 miles southeast-by-east of New Zealand; so called from being nearly antipodal to Greenwich, England. Its area is about 11 square miles.

An'tipope, a pontiff elected in opposition to one canonically chosen. The first antipopes were: Felix, during the pontificate of Liberius (352–366) and recognized during the absence of Liberius; Ursinus, against Damasus (366–384); Eulalius, against Boniface I. (418–422); Laurentius, against Symmachus (498–514); Dioscurus, against Boniface II. (530–532); Vigilius, against Sylverius, until 540, then canonical; Constantine, against Paul (767); Anastasius, against Benedict III. (855); John XVI., Philogathus, against Gregory V. (996–999); Gregory, against Benedict VIII. (1012–24). During the Middle Ages several emperors of Germany set up Popes against those whom the Romans had elected without consulting them. Otho the Great displaced successively two Bishops of Rome; and when the rival Pope, Sylvester III., had expelled the simoniacal and profligate Benedict IX. (1033–45), the latter was brought back by the German king, and soon afterward relinquished his dignity in consideration of a large tribute. Gratianus, who had persuaded him to yield, was now named Pope by the Romans as Gregory VI. There were, consequently, three Popes, but their claims were all set aside at a council convened at Sutri by the emperor, Henry III., and a new Pope elected as Clement II. in 1046. Shortly after, Pope Alexander II. found a rival in Honorius II., the nominee of the emperor; but his claim was ratified by a council convened at Mantua. In 1080 the same unseemly spectacle was witnessed, when the emperor Henry IV. elevated to the papal chair Guibert of Ravenna, under the title of Clement III., in opposition to his own implacable adversary, Gregory VII. After the death of Gregory (1085), Clement was antipope successively to Victor III. (1087–88) and Urban II. (1088–99). Other antipopes at this period were Albert, Theodoric, Maginulf, all in one year (1100–01); Maurice Burdin, against Gelasius II. (1118–19) and Calixtus II. (1124–30) Innocent II. (1130–43) triumphed over the antipope Anacletus II. by the help of St. Bernard; and Alexander III., during his pontificate (1159–81), had to contend with three successive antipopes, the election of only one of whom, however, Victor IV., in 1159, has any appearance of canonical validity. The others were named Pascal III. (1168) and Calixtus III., the same year. After a long contest Clement V. was elected in 1305, and four years later transferred his seat to Avignon, where his successors reigned for nearly 70 years, losing the while, by their subjection to French influences, the sympathies of Germany and England. Nicholas V. (1328–30) was antipope against John XXII. The election of Urban VI. in 1378 occasioned "the great schism of the West," which divided the Church for 50 years. He was elected by the Romans, who demanded an Italian Pope after the death of Gregory XI. The French cardinals, then a majority in the curia, on the plea that they had elected the Pope only under intimidation, withdrew to Provence, and elected an antipope under the name of Clement VII., who was recognized by France, Spain, Savoy, and Scotland; while Italy, Germany, England, and the whole North of Europe supported Urban VI. For 38 years Christian Europe was scandalized by the spectacle of two Popes, one at Geneva, another at Rome, in turn hurling the most awful anathemas of the Church at each other. At the beginning of the 15th century an attempt was made to prevail on both the rivals, Gregory XII. at Rome, and Benedict XIII. at Avignon, to renounce their claims with a view to promote union, but both evaded this as long as possible. At length, however, the cardinals attached to either court agreed to summon a general council, which met accordingly at Pisa in 1409. The council deposed both Popes and constituted the separate bodies of cardinals into one conclave which elected Alexander V. to the papal chair. The schism was finally healed when the council of Constance deposed John XXIII., and Gregory XII. and Benedict XIII. agreed to abdicate and recognize as Pope Martin V., against whom Peter de Luna and Munoz of Barcelona were antipopes. The council of Basel (1431–47), in its struggle with Pope Eugenius IV. (1431–47) for supremacy, attempted to arrogate to itself the papal functions and proceeded to elect Amadeus of Savoy Pope as Felix V. The attempt, however, failed; the Popes Eugenius IV. and Nicholas V. (1447–1455) secured their authority, the ambitious council finally dissolved itself, and Felix V. resigned his empty dignity, and was raised to the rank of cardinal by the magnanimous Pope himself. This was the last occasion on which the faithful were distracted by the sight of a rival pontiff within Christendom.

An'tipyret'ics, the name given to remedies employed to reduce temperature in diseased conditions. Direct application of cold in the form of baths, packs, ice-cloths, etc., are the most valuable and efficient antipyretics. In some definite affections, notably in malaria, quinine, by

destroying the parasite that causes the disease, reduces the temperature. Of late years a large number of synthetic drugs have been introduced to be used for the purpose of reducing temperature in disease. These are more technically the antipyretics. The field of their usefulness in this particular function, however, is constantly narrowing, since it is being recognized that fever is only a symptom and often not a dangerous one at that. Rational therapeutics would first eliminate the cause of fever, and drugs are then rarely necessary. The more important drug antipyretics are antipyrin, opium, quinine and its allies, salicylic acid and its compounds, alcohol, chloral, squills, phenacetin, and others of the modern analgesics (q.v.). The most important of the functions of most of these drugs is their power to relieve pain. Their antipyretic action is often extremely complex — in general they diminish oxidation, increase perspiration, or diminish the force and frequency of the heart-muscle contractions. See ANALGESICS; ANIMAL HEAT; FEVER.

An'tipy'rin, the trade name of an artificial alkaloidal substance known to the chemist as oxydimethyl-quinizin, or, more accurately, as oxy-phenyl-di-methyl-pyrazole. It is a crystalline substance melting at 235° F. and soluble in water, alcohol, and ether. Antipyrin is a derivative of coal-tar, an organic nitrogenous basic compound (synthetic alkaloid?) with the composition $C_6H_5(CH_3)_2C_3HN_2O$. It forms colorless scaly crystals devoid of odor and with a slightly bitter taste. It is soluble in water, alcohol, and chloroform. It is one of the first of the modern army of synthetic drugs, and is still one of the most valuable, though not so extensively lauded as formerly, the patent on its exclusive production by one manufacturer having expired in 1899. Its action locally is somewhat antiseptic, and solutions applied to mucous membranes render them slightly anæsthetic and contract the blood-vessels. It therefore makes a good local application to catarrhal membranes. Taken internally it is readily absorbed, reduces the force and frequency of the heart action, causes a dilatation of the blood-vessels of the periphery of the body, thus bringing about sweating and increased heat elimination (see ANIMAL HEAT). Its chief antipyretic action is due to the co-ordinating mechanism which lowers the heat at the point where the temperature is maintained and accumulated (the skin); the dilatation of the capillaries brings about the dissipation of this accumulation, which vascular dilatation is caused by the action of the heat-regulating mechanism possibly situated at the base of the cerebrum. Antipyrin is also an efficient and valuable analgesic, particularly serviceable in headache, neuralgias, in dysmenorrhea, in rheumatism, and in affections of the peripheral nerves and joints generally. By its pain-relieving qualities it makes a valuable adjunct in hypnotic mixtures. It is also a good antispasmodic (q.v.).

Antipyrin is mainly eliminated by the kidneys. It may cause symptoms of poisoning. These are collapse, cold extremities, and some degree of cyanosis and heart weakness. It is not one of the anilin (q.v.), analgesic antipyretics and hence has not the characteristic blood-poisoning properties of the anilins (acetanilid, exalgen, methacetin, and similar bodies). It also produces a number of untoward symptoms, notably skin eruptions, cramps of the intestine and of the bladder. It also may cause disturbances of sensation in the extremities. Doses of from 10 to 15 grains have caused serious symptoms of poisoning, particularly in children. See ANALGESICS; ANTIPYRETICS.

An'tiquaries, persons devoted to the study or collection of antiquities. In most of the countries of Europe and America there are important associations of antiquaries. The object of these societies is the collection and preservation of ancient manuscripts, inscriptions, coins, sculptures, etc.; the examination of ancient edifices and other remains; in short, the investigation of everything likely to throw light on the manners, customs, and history of the past. The chief antiquarian society of Great Britain is the Society of Antiquaries of London, founded in 1572, revived in 1707, and incorporated in 1751. The president for the time being is an official trustee of the British Museum. It has published 'Archæologia' (1770, etc.), 'Vetusta Monumenta' (1747), and 'Proceedings' from 1849. The Society of Antiquaries of Scotland was founded in 1780 and incorporated in 1783. The Archæological Institute of Great Britain and Ireland, established in 1843, is a society of similar character. The American Antiquarian Society (q.v.) was organized in 1812.

An'tiquary, The, a romance by Sir Walter Scott (1816). It is weak in its supernatural machinery, but strong in dialogue and humor. The plot centres about the fortunes and misfortunes of the Wardour and Glenallan families, and the chief character is Mr. Jonathan Oldbuck, the Antiquary, whose odd sayings and garrulous knowledge are inimitably reported.

Antiques', a term specifically applied to remains of ancient art, such as statues, paintings, vases, cameos, and the like, and more especially to works of Grecian and Roman antiquity.

Antiq'uities of the Jews, The, a famous work by the historian Flavius Josephus, concluded in the 13th year of the reign of Domitian. It was addressed especially to the Greeks and the Gentiles.

Antiq'uity, a term generally denoting the time prior to the irruption of the barbarians into the Roman empire in the middle of the 5th century, or previous to our era. In a narrower sense it is applied to the period over which the ancient history of the two principal nations of former times, the Greeks and Romans, extends. The name antiquities is commonly given to the remains of ancient art and industry, such as tools, weapons, sculptures, inscriptions, etc. It is also used in a wider sense to signify anything appertaining to a knowledge of the politics, manners, religion, literature, and arts of the nations of antiquity, or of the modern nations, until the existing order of things commenced. See ARCHÆOLOGY.

Anti-Rent Agitation, in New York State. Although the manorial system of large landed estates with leasehold tenants disappeared early in all other parts of the northern States of the Union, it flourished vigorously along the Hudson and Mohawk until well into the 19th century. This was due probably to the high per-

sonal qualities and tenacious landlordship of the Van Rensselaer (q.v.) and Livingston (q.v.) families, and the desire they inspired in others to become semi-feudal country gentlemen of the same stamp. The greatest of these holdings was the Van Rensselaer patroonship, called Rensselaerswick, derived from a Dutch grant confirmed by James II.; originally comprising the entire counties of Albany, Rensselaer, and Columbia,— 20 miles on each side of the Hudson,— and to the last retaining many hundreds of large farms in them. Almost as large was the "Livingston Manor," at one time holding 162,000 acres in Dutchess and Columbia counties. The extensive Hardenburgh Patent, dating from 1749, occupied large sections in Greene and Delaware counties; and there were many other considerable estates. The tendency in the vicinity of these great manors was not to sell farms, but lease them with feudal incidents, in imitation of their great neighbors; so that in eight or ten of the east-central counties a large part of the land was in tenant farms, mingled with and surrounded by properties in fee. There were some very annoying provisions in some leases; one for giving the landlord a quarter of the proceeds of the sales of produce in case of alienation of the fee, making the landlord a partner with a one-fourth interest. In practice this provision was either not enforced or was commuted for a fraction of the value, and in the Hardenburgh Patent, where was the fiercest resistance and the most bloodshed, there was no such provision at all; but it served as a common grievance whether present or absent. Also rents were often in kind, fixed or shares, which is always fertile in heartburnings; many, however, had been commuted to money. But the actual grievances were slight, and the tenants were probably better off in income than the owners in fee. In Rensselaerswick the first seven years of a lease were usually rent-free; on the Hardenburgh Patent five years, with the next five at half rent; and arrears and reservations were very laxly enforced, often not at all for years,— which was injudicious charity and produced the crisis, as enforcement of back dues meant being sold out and evicted, and agriculture is the one employment that will not endure that from private owners. The insecurity of the old feudal tenures had been removed by the legislation of 1779 and 1789, which abolished them; and the new leases, though having the same rentals and services, were in fee, so that raising of rent and confiscation of improvemnts were impossible. Further legislative regulation was attempted in 1812 to settle the respective rights of patroons and tenants; but the friction continued, and naturally involved all other land dealings,— contracts, mortgages, etc., having as ill an odor as leases. In 1836 a mob in Chautauqua County destroyed a land office with its records, on a rumor that the mortgages were to be foreclosed; and the same thing was only prevented at Batavia by an armed gathering of the townsmen. The matter was brought to a head by the death of Gen. Stephen Van Rensselaer, the eighth patroon of Rensselaerswick. This fine old gentleman, who commanded at Queenston Heights and founded Rensselaer Polytechnic Institute (q.v.), died early in 1839, leaving over $200,000 of uncollected rents and any number of unenforced quarter-sales, and two heirs to whom he left his estates on the respective sides of the Hudson. These heirs undertook to collect the arrears and enforce the rights left in abeyance; and the tenants formed associations to resist. The first to do so were those in the Helderberg Mountains, west of Albany (whence the disturbance is sometimes called the Helderberg war); but those east of the Hudson in Rensselaer County outdid them by forming a mob in disguise and murdering a man. The counties were in open rebellion, and in December Gov. Wm. H. Seward issued a proclamation against the rioters. The sheriff of Albany County with a posse several hundred strong was stopped by 1,500 armed men: a company of militia was called out, but was forced back by a gathering of nearly 1,000, and at last a body of about 1,000 militia had to be sent to Albany. The executions were finally levied, and on the 12th the soldiers were sent home. On the governor's recommendation the legislature appointed a commission to report on a plan of adjustment; but as the only parties who wished the legal *status quo* changed were the tenants, the landlords considered the concessions to be all on their side and refused to listen to its recommendations. A stubborn resistance practically nullified the collection of rents year after year. At length in 1844 the rebellion broke out with tenfold violence, in a general organization through Rensselaer, Schenectady, Columbia, Otsego, Delaware, Ulster, Greene, Dutchess, and other counties, against the payment of any rent whatever, and to compel the lords of the manor to sell their lands to the persons occupying them as tenants. The justifications legal and equitable may be surmised: that the landlords had no title, that the rent had been waived, that the payment of rent was against republican insitutions, etc. A regular agrarian war was instituted: the tenants, plus all the rabble who liked to commit outrage on any side, disguised themselves as Indians in defiance of laws against it, and began a reign of terror, flogging, tarring and feathering, boycotting, and generally ill-using all who took leases, dealt with landlords, or obstructed obstruction in any way. One laborer who had bought lumber from a leased farm and was taking it to market was shot dead by a mob in a struggle to take it from him. At length, on 7 Aug. 1845, a deputy sheriff of Delaware County was fatally shot by such a mob while serving a process; the extortion which called for this bloodshed was two years' back rent at $32 a year. These performances went on for months; Gov. Silas Wright, who in his message of 1845 had favored commutation of rents and ownership in fee though calling for sharp laws to punish outrages, now summoned a military force and sternly put down the rebellion. More than 50 convictions were obtained, two of murder with sentence of death, which the governor commuted to imprisonment for life; but in his next year's message (1846) he recommended the abolition of distress for rent and the limitation of leases to five or ten years. The constitutional convention of 1846 abolished feudal tenures and limited leases to twelve years. This was not at all what the Anti-Renters wanted, however, but abolition of rent altogether and proclamation of the lease-holders as owners. Their cause had been an

issue in State politics for years, fomented by agitators and newspapers; and the Whigs, seeing that they controlled the legislative delegations of eleven counties, nominated for governor in 1846 their chief legislative champion, John Young, against Silas Wright, elected him by their aid, and he promptly pardoned all those who had been sentenced, pronouncing their offenses "political." He also recommended State suits against landlords to try titles. The Anti-Renters had "adopted" a part of the State ticket and not the rest, to show their strength, and polled about 5,000 votes; the next election (of 1848) they did the same: and the legislature, alive to the value of this body of votes, directed the attorney-general to bring a test suit against Harmon Livingston. The decision in November 1850 was for Livingston; but the nearly twelve-years struggle and ruin of property values had wearied the landlords, and the decent tenants were perhaps ashamed of their breach of contract. The former offered to sell the farms, and the latter were willing to buy; and the great patroonship and patents were rapidly broken up. Meantime there was a mass of private litigation, and several cases went up to the Court of Appeals; which in October 1852 declared that without reference to the Constitution of 1846, agreements in restraint of alienation of titles in fee, and therefore reservations of quarter-sales, were void. As this left the landlords no right which could oppress the tenants, and the latter nothing to oppose except a payment of honest debts, the Anti-Rent agitation passed out of sight as a dignified political entity. But the spirit was not quite dead. As late as July 1866 an anti-rent riot broke out in Knox, Albany County, which had to be suppressed by the militia. The next month a landowner's agent in Berne was fired at and his horses were shot. These, however, were belated estrays: for a generation land contracts have been on a footing with all others. Consult Jay Gould, 'History of Delaware County' (1856); Roberts, 'History of New York' (1887); Cheyney, 'Anti-Rent Agitation' (1887).

An'tirrhi'num, the designation of a genus of annual or perennial plants of the natural order *Scrophulariaceæ,* commonly known as snapdragon, on account of the peculiarity of the blossoms, which resemble a face or a mask. They all produce showy flowers and are much cultivated in gardens. Many varieties of some of them, such as the great or common snapdragon (*A. majus*), have been produced by gardeners. The plant is not native in America, such specimens as are seen growing wild having escaped from gardens.

Antisana, än'te-sä'na, a volcano in the Andes of Ecuador, 35 miles southeast-by-east of Quito. Whymper, who ascended it in 1880, makes its height 19,260 feet.

An'tisci'an (Greek *anti,* over against; *skia,* a shadow), a name applied to those who live under the same meridian, at the same distance north and south of the equator, and whose shadows at noon consequently are thrown in contrary directions.

An'tiscorbu'tics. See SCURVY.

An'ti-Sem'itism, a name applied to a movement against Jews as such, the modern opponents of the Jews in Russia, France, and Germany. It is founded on race hatred and arises from social, economic, and political causes. In Berlin an Anti-Semitic League was formed in 1879 to restrict the liberty of Jews in Germany. Since then similar organizations have been formed in Russia, Austria, Greece, and Holland. The movement in Russia assumed a more brutal character than in Germany, and thousands of Jews fled to the United States, Spain, and elsewhere. In Hungary violent anti-Jewish riots occurred at Pesth, Zala, and elsewhere, which were not brought to an end until martial law was proclaimed. The second trial of Capt. Albert Dreyfus, in 1899, aroused an intense anti-Semitic feeling in France. See JEWS AND JUDAISM.

An'tisep'tic, a term denoting that which arrests decay. The development of the knowledge that organic bodies are broken down or decayed by minute plants, fungi, bacteria, etc., led to the idea of preventing the action of these bodies by the employment of some appropriate substances. In medicine it had been found that many of these bacteria produced a condition known as *sepsis,* or poisoning, and when Lister first used the carbolic spray to prevent the development of these bacteria the word *antiseptic* came into use. Used originally to apply to septic organisms it has come to be applied to any substance that would inhibit the growth or destroy these agents of putrefaction or of disease. A *germicide* is any agent that kills these low forms of plant life; *fungicides* are used on the large fungi; *bactericides* on the bacteria. The word *disinfectant* should properly apply to a substance used for the destruction of a definite infecting agent, such as phthisical sputum, or typhoid urine or stools, but it too often is employed for some remedy that destroys a disagreeable odor — a *deodorant.* Thus most so-called disinfectants, manufactured to place in closets or urinals, are really nothing but foul-smelling deodorants. As disinfectants they are delusions and snares. Germicides, bactericides, antisepticides, may be divided into two groups, physical and chemical. In the former group is heat, the most important of all germicides. Burning is the best means for the disinfection of the non-valuable surroundings of patients who have had any severe contagious disease such as diphtheria, typhoid fever, plague, scarlet fever, etc. It is the best agent for the destruction of all tuberculous sputum. Boiling is another efficient means of disinfecting, or sterilizing. The boiling of water or milk suspected to contain the bacteria of typhoid or diphtheria is efficient. Boiling all bed linen in contact with contagious diseases is advisable.

The boiling of preserves and then hermetically sealing the cans to prevent the entrance of molds is practised by all housewives. When the fruit "ferments," it has either not been boiled long enough, the cans were not thoroughly cleansed by boiling water, the rubbers and tops not sterilized, or a hole has been left whereby the spores of molds have entered. Cold is a preservative only: it prevents the multiplication of these low forms of plant life, but does not destroy them.

Chemical antiseptics have been in vogue ever since the work of Tyndall, Pasteur, Koch, and Lister showed the role of lower plant forms in the causation of putrefaction and sepsis. In the arts many antiseptics are used to preserve foods. The smoking of hams, etc., is the old empirical method, antedating modern means probably by hundreds of years, the smoke containing creosote and bodies related to carbolic acid. Boracic acid, alum, salicylic acid, formalin, nitre, common salt, sugar, etc., are all extensively used as food preservatives. Wood is protected from rotting by the injection of creosote, tar, and related fungicides. In modern antiseptic surgery it is not the destruction of bacteria, but rather their prevention, that is desired, and *asepsis* is the modern method, not *antisepsis.* By thorough sterilization of everything that comes in contact with a patient's body the modern surgeon prevents infection by keeping bacteria out. Should the nature of a wound be such that it is already infected, then antiseptics are of service. The most valuable surgical antiseptics are the phenols and their derivatives (carbolic acid, salicylates, etc.), salts of mercury, silver, lead, aluminum, copper, and zinc, preparations of chlorin, iodin, bromin, organic aldehydes, formaldehyde, benzaldehyde, and the oxygen-producing compounds, hydrogen peroxide and other peroxides. For the comparative strength of the antiseptics see under their respective heads. Also Sternberg, 'Bacteriology'; Flügge, 'Die Mikroorganismen.' See BACTERIA; FUNGI; INFECTION; KOCH; PASTEUR; PUTREFACTION; SPONTANEOUS GENERATION.

Anti-Slavery Society, the American, was organized in Philadelphia, Dec. 1833, by delegates from similar local and state societies. The first of these societies was formed in Boston in Jan. 1832, by William Lloyd Garrison and others. The American society took a radical stand for the abolition of slavery. A difference of opinion among the members caused a split in the society in 1840, and eventually both factions joined the Liberty Party (q.v.). A small coterie of the original society continued to exist however until the adoption of the 15th Amendment in 1870. See LIBERAL PARTY; SLAVERY.

An'tispasmod'ic, a medicine proper for the cure of spasms and convulsions. Opium, balsam of Peru, and the essential oils of many vegetables are the most useful of this class of medicines.

Antis'thenes of Athens, a Greek philosopher who founded the sect of Cynic philosophers; b. in Athens 444 B.C. He was a disciple of Socrates, and is said to have aided in bringing some of his persecutors to justice. He taught at the Cynosarges, a gymnasium appropriated to Athenians who had foreign mothers. His philosophy was a one-sided development of the Socratic method. According to his teaching virtue should render man independent of the ordinary events of life. He himself lived in a very austere, self-denying fashion.

Antis'trophe, (Gr. *anti*+*strophē*, from *strephō*, I turn), the name of one of the divisions of a Greek choral ode, corresponding to the *strōphē* and following it. The singing of the strophes on the stage was accompanied with a motion or turn from right to left.

An'titox'ins, the name given to peculiar bodies developed in the human body or in the body of an animal, supposed to be antagonistic to the poisons, or toxins, of disease. These antitoxins are specific for definite diseases and constitute one of the protective agents in the body's battle with disease. For the full consideration of these and other similar bodies see IMMUNITY.

An'ti-trade, a name given to any of the upper tropical winds which move northward or southward in the same manner as the trade-winds which blow beneath them in the opposite direction. These great aërial currents, descending to the surface after having passed the limits of the trade-winds, form the southwest or west-southwest winds of the north temperate, and the northwest or west-northwest winds of the south temperate zones.

An'titrin'ita'rian, a name applied to one who does not receive the doctrine of the divine Trinity as it is represented by the Nicene and Athanasian creeds, and either puts the Son and the Holy Spirit in the Godhead below the Father, or considers Christ as merely a man, and the Holy Spirit an arbitrary personification of the divine mind. Antitrinitarians of the latter class are Unitarians (q.v.), while those of the former class are relatively Trinitarians.

Anti-Trust Laws, in the United States. (See also TRUSTS.) The first of these on the statute books was an ordinance of Alabama in 1883 against the pooling of freights by railroads. The first general law against business combinations was enacted by Kansas in 1889. But the general movement against trusts which took shape in legislation was in 1889, when five States and Territories passed laws to render combinations in restraint of trade illegal and punishable, and two more (Washington and North Dakota) incorporated similar provisions into the constitutions with which they were admitted to the Union. In the first half of 1890 three more States joined the movement with legislation; and on 2 July the Federal Congress enacted the "Sherman Law" against trusts. Since then over as many more States and Territories, toward 30 in all, have placed like statutes on their books. The provisions are substantially alike in all, making the persons engaged in such combinations liable to fine and imprisonment, and the corporations or firms punishable by loss of charter or of right to carry on business within the State where the offense is committed. The decisions of the circuit courts at first were so narrowed as practically to nullify the provisions of the laws; it being held that the combinations, as at common law, must be proved inequitable and injurious to the public, and calculated not merely to abate competition, but absolutely to monopolize the business for the purpose of extortion. But these decisions were reversed by the United States supreme court, which held that the laws made no distinction between partial and complete monopoly, or equitable and inequitable. It had been claimed also that the laws were unconstitutional, as violating the Fifth and Fourteenth Amendments, that no person shall be deprived of liberty without due process of law, and that the liberty of making contracts is an essential portion of this: but the supreme court interprets them to mean legal contracts, and

that under its power to regulate commerce Congress can decide what contracts are legal; while the State courts hold that such regulation is competent to the States under their police power.

The Sherman Act is as follows:

1. Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations is hereby declared to be illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a misdemeanor, and on conviction thereof shall be punished by fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

3. Every contract, combination in the form of trust or otherwise, or conspiracy in restraint of trade or commerce in any Territory of the United States or of the District of Columbia, or in restraint of trade or commerce between any such Territory and another, or between any such Territory or Territories and any State or States or the District of Columbia, or with foreign nations, or between the District of Columbia and any State or States or foreign nations, is hereby declared illegal. Every person who shall make any such contract or engage in any such combination or conspiracy shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by fine not exceeding $5,000, or by imprisonment not exceeding one year, or by both said punishments, in the discretion of the court.

4. The several circuit courts of the United States are hereby invested with jurisdiction to prevent and restrain violations of this act, and it shall be the duty of the several district attorneys of the United States in their respective districts, under the direction of the attorney-general, to institute proceedings in equity to prevent and restrain such violations. Such proceedings may be by way of petition setting forth the case and praying that such violation shall be enjoined or otherwise prohibited. When the parties complained of shall have been duly notified of such petition the court shall proceed, as soon as may be, to the hearing and determination of the case; and pending such petition, and before final decree, the court may at any time make such temporary restraining order or prohibition as shall be deemed just in the premises.

5. Whenever it shall appear to the court before which any proceedings under section four of this act may be pending, that the ends of justice require that other parties should be brought before the court, the court may cause them to be summoned, whether they reside in the district in which the court is held or not; and subpœnas to that end may be served in any district by the marshal thereof.

6. Any property owned under any contract or by any combination, or purchased to any conspiracy (and being the subject thereof) mentioned in section one of this act, and being in the course of transportation from one State to another, or to a foreign country, shall be forfeited to the United States, and may be seized and condemned by like proceedings as those provided by law for the forfeiture, seizure, and condemnation of property imported into the United States contrary to law.

7. Any person who shall be injured in his business or property by any person or corporation by reason of anything forbidden or declared to be unlawful by this act, may sue therefor in any circuit court of the United States in the district in which the defendant resides or is found, without respect to the amount in conspiracy, and shall recover threefold the damages by him sustained, and the cost of suit, including a reasonable attorney's fee.

8. That the word «person» or «persons,» wherever used in this act, shall be deemed to include corporations and associations existing under or authorized by the laws of either the United States, the laws of any of the Territories, the laws of any State, or the laws of any foreign country.

An'titype, a word denoting a type or figure corresponding to some other type. It is in the sense of copy or likeness that the word occurs in the New Testament (Heb. ix. 24; i Peter iii. 21). By the fathers of the Greek Church antitype is employed as a designation of the bread and wine in the sacrament of the Lord's supper.

Antium, ăn'shĭ-ŭm, one of the most ancient and powerful cities of Latium, the chief city of the Volsci. It was situated on a promontory, and was a flourishing seaport. It was taken by the Romans in 468 B.C., but soon revolted, and maintained its independence till finally taken by Rome in 338 B.C., and after this it appears as one of the maritime colonies of Rome. Toward the close of the republic and during the empire it was a favorite residence of the wealthy Romans, and both the town and its neighborhood were adorned with temples and splendid villas. Nero and Caligula were born at Antium. It was entirely destroyed by the Saracens; but vestiges of it still remain at Porto d'Anzo, its modern successor, near which many works of art, including the Apollo Belvidere and the Borghese Gladiator, have been found.

Ant'lers, the weapons borne upon the head of a male deer during the breeding season. They are an outgrowth of true bone supported upon protuberances from the crown of the skull, called pedicels. As the spring approaches, the hairy skin with which these are covered becomes highly vascular and swollen with blood and serum carrying lime salts. This grows outward and gradually assumes the form of the antler, characteristic of the species, which for a time is in a soft and vascular state, and covered with what hunters call «velvet.» There is continually deposited within this growth the substance of bone, which fills and solidifies the structure from the centre outward, until in the course of four or five months all has become solid, the outer skin shrinks and dries and

presently falls or is rubbed off. These antlers remain firm upon the head and useful as weapons until the middle of the following winter, when they become loosened and fall off. The process is repeated the following spring, and the antlers are thus lost and replaced annually as long as the stag lives. In the deer, with the single exception of the reindeer, antlers are worn only by the males and are a secondary sexual character. That they are associated with the reproductive function, says Beddard, is shown by their being shed after the period of rut; and also by the stunting effect upon the horns which any injury to the reproductive glands produces. Various degrees of degeneration are to be seen in the antlers of captive deer resulting from varying degrees and periods of gelding.

The sport of stag-hunting has preserved a set of ancient terms, mostly of French origin in the Middle Ages, designating the different parts of the antler and the successive stages of growth, and these have come to stand for a deer of a certain age or condition. They were all derived from and particularly applicable to the European red deer (*Cervus elephas*), which more than any other species is preserved for hunting in Europe. This nomenclature is summarized as follows in 'Cassell's Natural History,' Vol. III.—"In the common red deer, in the spring of the year following its birth, the antlers are nothing more than straight, conical, and unbranched 'beams,' the animal being then known as a 'brooket.' In the following spring the antler has, besides the 'beam,' a small branch from its base, directed forward, known as the 'brow antler'; it is then termed 'spayad.' In the third year an extra front branch is formed, known as the 'tres,' and the whole antler is larger. The tres is sometimes seen in the smaller antler of the spayad. In the fourth year the brow antler is doubled to form the 'brow' and the 'bez-tine,' at the same time that the top of the main beam divides into the 'sur-royals' of the 'staggard,' or four-year-old male. In the fifth year the sur-royals become more numerous, the whole antler of the 'stag' being heavier than previously, only to be exceeded in weight by those of the fully adult 'great hart' with ten or more 'points,' each being larger and longer than the year before." A deer of 12 points is known in Scotland as a "royal stag," but although sometimes antlers have more than 12 points, no recent antlers quite equal those which have been preserved from old times before all the best deer were so systematically shot each year. Where the number of points is exceedingly large, as it is in some curious specimens whch show fifty or seventy-five, they are no longer a record of the years of the animal's life, but of injuries to the horns, causing unnatural branchings. The horn of antlers is of commercial value, being much used for the handles of knives and similar articles.

Ant'lia, or **Antlia Pneumatica,** the name of one of the 14 southern constellations placed in the heavens by Lacaille in connection with his work at the Cape of Good Hope in 1751–2. It is situated between Vela, Pyxis, Hydra, and [illegible].

Ant'-li'on, a term applied to the larva of *Myrmeleon*, a neuropterous insect of the family *Myrmeleonidæ*. It is a singular-looking creature, the body somewhat broad and flattened behind, the head provided with enormous jaws which have a groove beneath, in which the maxillæ slide back and forth. It can thus pierce the bodies of small soft-bodied insects, flies, etc., and suck their blood without moving the jaws on which the victim is impaled. It makes a pit in fine sand, at the bottom of which it lies with its body buried and its jaws wide open, ready to seize any luckless insect which may fall in. When an insect comes near the edge of the pit, the ant-lion, by a toss of its head, hurls at it a shower of sand, which knocks it down, so that it slides into the pit and is seized. Ant-lions are known in confinement to spend the winter in the larval state if fed with flies, caterpillars, and spiders. In the spring the larva spins a rather large, round, silken cocoon covered with grains of sand, within which it changes to a pupa, and the winged insect emerges early in June. The imago has long gauzy wings, both pairs alike, and is rarely seen in the northern and eastern States. The conical, crater-like pits of the ant-lion may be seen in sheltered places in loose sand to the number of from 50 to 75. It occurs from Maine to Florida.

Antofagasta, än'tō-fa-gäs'ta, a province in northern Chile, extending the whole width of the country and covering an area of 60,968 square miles. It was ceded by Bolivia to Chile in 1884. Much of its territory lies in the rocky desert of Atasama, a feature which makes it generally unsuitable for agriculture. It is, however, one of the richest sections of the world in the ores of precious metals. Pop. 50,000. Antofagasta, its capital and principal seaport, is the terminus of a railroad that extends to the rich mining sections in the northeast. It also ships much ore, nitrate of soda, and bullion, and contains silver-smelting works. Pop. (1901) 19,482.

Antommarchi, än'tōm-mär'ke, **Carlo Francesco,** an Italian physician: b. in Corsica in 1780; d. in St. Antonio, Cuba, 3 April 1838. He was professor of anatomy at Florence when he offered himself as physician of Napoleon at St. Helena. Napoleon at first received him with reserve, but soon admitted him to his confidence, and testified his satisfaction with him by leaving him a legacy of 100,000 francs. On his return to Europe he published the 'Derniers Moments de Napoléon' (1823). He also wrote the text for a folio series of anatomical plates published in 1823–6, and in 1830 exhibited what he asserted to be a death mask of Napoleon. In 1836 he went to New Orleans, where he practised homœopathy.

Antonelli, ä'tō-nĕl'le, **Giacomo, Cardinal,** an Italian ecclesiastic: b. 1806; d. 1876. He was educated at the Grand Seminary of Rome, where he attracted the attention of Pope Gregory XVI., who appointed him to several important offices, and on the accession of Pius IX., in 1846, Antonelli was raised to the dignity of cardinal-deacon. Two years later he became president and minister of foreign affairs, and in 1850 was appointed secretary of state. During the sitting of the Œcumenical Council (1869–70) he was a prominent champion of

the papal interest. He strongly opposed the assumption of the united Italian crown by Victor Emmanuel.

An'tonine Column, the name given to the sculptured pillar erected by Marcus Aurelius to the memory of his father-in-law, Antoninus Pius. The splendid staircase, with 190 steps hewn in the 19 blocks of marble of which the column is composed — the statue of St. Paul crowning its top — and the bas-reliefs around the column illustrating the victories of Marcus Aurelius over the Marcomans, present an appearance of singular magnificence. The Doric and Corinthian styles are blended in the architecture of the column in a remarkable manner. The pedestal and top are Doric, while the proportions of the column are Corinthian. The bas-reliefs, in imitation of those of the column of Trajan, are in beauty and purity of execution rather inferior to the original. The column was restored to its present condition in the latter part of the 16th century by Domenico Fontana, the architect of Sixtus V., and still stands in the Piazza Colonna as one of the chief ornaments of Rome.

Anto'nius Gaius, a Roman consul, the colleague of Cicero, who defended him when accused of participation in the Catiline conspiracy. He was the son of Marcus Antonius the orator, and an uncle of Mark Antony.

Antonius, Marcus, commonly known as Mark Antony, a Roman triumvir: b. 86 B.C.; d. 30 B.C. He was the grandson of Marcus Antonius, the greatest orator and one of the greatest men of his day. His father, also Marcus Antonius, was surnamed Creticus in derision, from a disgraceful defeat which he suffered in an unprovoked invasion of the isle of Crete. He went abroad early, served with Gabinius in Syria, and distinguished himself greatly, both there and in Egypt, where he already gave tokens of consummate soldiership. He next joined Cæsar in Gaul, where he passed several campaigns with increasing honor as one of his legates, and deserved much of the credit, usually given to his leader, for the total defeat of Vercingetorix at the terrible siege of Alesia. Being elected one of the tribunes of the people, when the senate ordered Cæsar to disband his forces, he, with Quintus Cassius, vetoed the bill; and, on the senate proceeding to arm the consuls with dictatorial power by the vote *ne quid respublica detrimenti capiat,* they fled together, disguised as slaves, to Cæsar's camp, feigning to believe that their lives were in danger, thus giving that ambitious general the deserved occasion for crossing the Rubicon and marching upon Rome. In reward for this service, when Cæsar went to follow up his fortunes by crushing out the Pompeian party in Spain, he left Antony governor of Italy and lieutenant-general of his forces. He astounded all Italy by the ostentation and cynicism of his vices, but when the last struggle took place between Pompey and his own commander, he at once laid aside the debauchee and resumed the soldier. His skill preserved the fleet and intrenchments at Dyrrachium; it was he who commanded the victorious left wing in the crowning conflict at Pharsalia, and turned the wavering tide of success to the standards of Cæsar. When the Ides of March had come, and great Cæsar fell at the base of Pompey's statue, it was the masculine and sonorous eloquence of Antony — for he was an orator second to Cicero and Cæsar only — that did actually raise the stones of Rome to mutiny and forced the discomfited murderers to fly from their half-finished task. It was Antony's soldiership and Antony's sword that defeated Cassius and drove Brutus to suicide, while the cold, cowardly, crafty Octavius was sleeping in his secure tent. In the proscriptions which followed it is characteristic of Antony that he was by so much the more insolent, as he was the less cruel, of the triumvirs. But the third triumvir, the imbecile Lepidus, was soon disposed of, and Octavius and Antony divided the Roman world, as masters. Antony took the East; Octavius, the cold formalist, betook himself to the West. Thenceforth the life of Antony was one wild dream. Once he broke from his luxurious lethargy, invaded central Armenia and penetrated Parthia; and then, forced to retreat at length by the circumstances of the country, the climate, the innumerable hordes of Oriental horse, brought off his army by a most extraordinary retreat. In 21 days he fought 18 pitched battles, marched 300 miles, through one continuous skirmish, and when he reached the boundary stream his Parthian pursuers unstrung their bows and bade him go his way unharmed. He returned to his life of luxury and to Cleopatra, but his career was run. Rome took arms against him; his troops, his mistress, his fortune deserted him; and Actium saw him, for the first time, with his back to his foes. Deceived to the last by the Egyptian queen, who imposed upon him by a false rumor of her death, he died by his own hand. Most like he was to Mirabeau in that he was everything at times, and everything almost the greatest, but nothing long — orator, soldier, statesman; trifler, buffoon; tribune, triumvir, conqueror; faithful lover, false husband, frantic debauchee; and, when the wine of life was quaffed to the lees, a fearless suicide at last.

Antonius, Marcus, a famous Roman lawyer surnamed the Orator: b. 143 B.C.; d. 87 B.C. He was prætor in 104, when he fought against the pirates in Cilicia; consul in 99, when he distinguished himself by his resistance to the party of Saturninus; and censor in 97. He was famed for his eloquence in the forum, rendering, according to Cicero, Italy the rival of Greece, and for his integrity in public life. As an aristocrat he adopted the party of Sylla, and was put to death by Marius and Cinna, when they triumphed. He is one of the interlocutors in Cicero's 'De Oratore.'

An'tony and Cle'opa'tra, the second of Shakespeare's Roman plays. In Cleopatra the gorgeous Oriental voluptuousness is embodied in the strong-thewed Antony, the stern soldier-power of Rome weakened by indulgence in lust. The poet follows Plutarch in his narrative. The rulers of the Roman world are Mark Antony, Octavius Cæsar, and their weak tool, Lepidus. While Antony is idling away the days in Alexandria with Cleopatra, in Italy things are all going wrong. At last Antony is shamed home to Rome. Lepidus and other friends patch up a truce between him and Cæsar, which is cemented by the marriage of Antony to Cæsar's sister Octavia. After the great defeat at Actium, Enobarbus and other intimate followers

deserted the waning fortunes of Antony. Being falsely told that Cleopatra is dead, Antony falls on his sword.

Ant Plants. See MYRMECOPHILY.

Antraigues, än'träg, **Emanuel Delaunay, Comte d',** a French politician: b. at Villeneuve de Berg, 1755; d. 22 July 1812. His talents first appeared in his 'Mémoires sur les Etats-généraux' (1788), full of daring assertions of liberty, and one of the first sparks of the fire which afterward rose to such height in the French Revolution. When chosen, in 1789, as a deputy, he defended the privileges of the hereditary aristocracy, ranked himself with those who opposed the union of the three estates, and maintained that the royal veto was an indispensable part of good government. After leaving the Assembly in 1790, he was employed in diplomacy at St. Petersburg and Vienna, where he defended the cause of the Bourbons. In 1803 he was employed under Alexander of Russia in an embassy to Dresden, where he wrote against Bonaparte a brochure entitled 'Fragment du XVIII. Livré de Polybe, trouvé sur le Mont Athos.' He afterward came to England and acquired great influence with Canning. He was murdered, with his wife, at his residence near London, by an Italian servant.

An'trim, a county in northeastern Ireland, bounded on the north by the Atlantic Ocean, east by the North Channel; south by the river Lagau and Lough Neaghand; west by the river Bann. It has an area of about 1,237 square miles, nearly all of which is under cultivation. There are rich beds of iron ore at Glenravel, and extensive mines of fine salt are being worked at Dunerul and Carrickfergus. The chief occupations of the people are the raising of flax, fishing, and the manufacture of linen, cotton, and heavy woolen goods. The capital is Belfast, and other places of note are Larne and Carrickfergus. Pop. (1901) 461,250.

The town of Antrim, situated at the north end of Lough Neagh, on the Six-Mile Water, is not a place of much consequence, though bleaching and malting and the linen and paper manufacture are carried on here. There is a very perfect round tower near it.

Ant'werp (Dutch, *Antwerpen;* French, *Anvers;* Spanish, *Amberes;* Old German, *Antorff;* from "aent werf," "on the wharf"), a province of Belgium, south of Holland, consisting for the most part of an extensive plain of 1,096 square miles, scarcely diversified by a single elevation. It is sandy but fertile, producing grain, flax, hemp, fruit, and tobacco, as well as cattle, sheep, and horses; on the north and northeast, however, there are considerable tracts of morass and heath. The principal rivers, the Scheldt and its tributaries, the Rupel, Nèthe, and Dyle, are navigable; while railways intersect the country in various directions, and there are also several canals. The chief towns are Antwerp, Mechlin (Malines) Turnhout, Lierre, and Boom. Pop. (1901) 819,000.

Ant'werp, the capital of the Belgian province of the same name, situated about 50 miles from the open sea, and 25 miles north of Brussels, in a level tract on the right bank of the Scheldt, which is there about 2,200 feet broad and has a depth at ebb-tide of from 30 to 40 feet, with a rise at spring-tides of 12 or 14. Antwerp was probably founded some time before the 8th century, when the Antwerpians or Ganerbians, as they began to be called, were converted to Christianity. In 837 the town fell into the hands of the Northmen, who kept possession of it for about 60 years. It was erected into a marquisate of the Holy Roman Empire by Henry II. in 1008, and as such was bestowed by Henry IV., in 1076, on Godfrey of Bouillon. About the beginning of the 12th century it had considerable commercial prosperity; and in the 13th its municipal institutions took definite shape. It is worthy of notice that the law of 1290 contained provisions identical with those of the Habeas Corpus Act in England, maintaining the inviolability of the citizen's dwelling, and acknowledging the right of every man to be judged by his peers and to have a voice in the imposition of taxes. As the result of such security and freedom the commerce of the city rapidly increased. English wools for the great manufactories at Louvain, Brussels, Tirlemont, Diest, and Leau, were imported through Antwerp; and English merchants, who formed a "factory" there in 1296, received special protection by charters (1305, 1341, 1346, 1349) from the Dukes of Brabant. Between 1488 and 1570 was the time of the greatest prosperity which Antwerp was destined to attain for several centuries. The discovery of America in 1492, and of the passage to India in 1497, produced a great change in all European navigation, permanently altering the old courses of commerce. While in consequence of this the cities of the Hanseatic League had withered, and Venice, Nuremberg, and Bruges were sinking into decay, Antwerp was rapidly growing wealthy, but in 1576 it was taken by the Spaniards and given up to a three-days pillage. It was vainly besieged by the Duke of Alençon in 1583; and after a very obstinate defense it fell before the assaults of the Duke of Parma, whose triumphal entry took place 17 Aug. 1585. Its glory departed; its commerce was ruined; its inhabitants were scattered. The Dutch in their jealousy endeavored to complete its ruin by building forts on the river to intercept the passage of ships; and finally, by the peace of Westphalia in 1648, the Scheldt was definitely closed. In 1794 the city fell into the hands of the French, who opened the river and made Antwerp the capital of the department of Deux Nèthes. It continued in French possession till 1814. Matters of dispute between Belgium and Holland being settled by the treaty of 1839, Antwerp has continued peacefully to advance in prosperity ever since.

Antwerp is the birthplace of a number of distinguished men in various departments, as the painters Vandyck (b. 1599), Teniers the elder (1582), Teniers the younger (1610), Jordaens (1594), Frans Floris (1520), Gonzales Cocques (1618); the philologist Gruter (1560), the geographer Ortelius (1527), the engraver Edelinck (1649), and, among more modern celebrities, Van Meteren the historian, Ogier the dramatist, and Henri Conscience the novelist. Reubens was born at Cologne, but his family belonged to Antwerp, and he was educated, resided, and died in the latter city.

The cathedral of Notre Dame is its most noteworthy edifice, the largest and most beauti-

ful Gothic structure in the Low Countries. Its area is 70,060 square feet and it contains Rubens' paintings, 'The Descent from the Cross,' 'Elevation of the Cross,' and 'The Assumption.' Other important buildings are the church of St. Jacques, begun in 1491, the Bourse, and the Museum. Pop., exclusive of suburbs (1891) 285,600.

A'orist (Greek, *aoristos,* «indefinite»), the name given to one of the tenses of the Greek verb, expressive of indefinite past time. The Greek verb is very rich in past tenses, possessing besides the aorist the imperfect, perfect, and pluperfect. While these express repetition, continuance, or the relation between one time and another, no such shade of meaning attaches to the aorist. The difference between the first and the second aorist is in form only and not in meaning.

Aor'ta, the name given to the great arterial trunk of the body. It springs from the left ventricle of the heart, arches backward to the vertebral column, and, descending in the back portion of the thorax, passes through the diaphragm into the posterior part of the abdomen, at the lower portion of which, opposite the fourth lumbar segment of the spinal column, it divides into the two common iliac arteries. Throughout its course it becomes smaller and smaller, and gives off a large number of branches, that send blood to all parts of the body. It is not divided into any distinct divisions, but for conventional purposes of description anatomists describe three parts, the arch, the thoracic aorta, and the abdominal aorta. The arch reaches to the lower border of the fifth thoracic vertebra; from this point to the opening in the diaphragm it is known as the thoracic aorta; from the diaphragm to its bifurcation into the iliacs, the abdominal aorta. At its very beginning at the top of the heart it gives off the coronary arteries that supply the walls of the heart with blood. The arch is then conventionally divided into three parts, the ascending, transverse, and descending portions. From the transverse portion of the arch the great vessels of the neck, head, and arms are given off,— the innominate or brachiocephalic artery, that goes to the head and upper extremity of the right side, the left common carotid, to the head on the left side, and the subclavian that supplies the upper extremity of the left side. There are really two large arteries supplying each side, but on the right they arise from the one branch from the aorta, while on the left side the arteries going to the head and to the upper extremities are separate. The thoracic aorta lies close to the spinal column in the chest. It supplies arteries extending to the walls of the chest and to all the viscera in the thorax, lungs, etc., save the heart. The abdominal aorta supplies the diaphragm, the muscles of the walls of the abdomen, the liver, kidneys, spleen, stomach, pancreas, suprarenals, the small and large intestines, the spermatic vesicles, and a part of the pelvis. The two great branches into which it finally divides supply the pelvic walls, the organs in the pelvis, the external genitals, and finally the lower limbs. There are a number of variations in the details of the distribution of the different large vessels of the aorta, but these concern the anatomist. The walls of the aorta resemble in their microscopical structure those of the arteries of the body save in possessing more elastic fibrous tissues. This is necessitated because of the greater pressure on this part of the circulatory apparatus. See ARTERY; CIRCULATION; HEART.

Aosta, ä-ōs'ta, a town of Italy, in Piedmont, 50 miles northwest of Turin. It is the seat of a bishop, and possesses a collegiate and three parish churches, two colleges, and two hospitals. Among its antiquities are a triumphal arch, erected to the memory of Augustus, who rebuilt the town and gave it the name of Augusta Prætoria; a gate with three arches, and the remains of an amphitheatre, and the old Roman walls which still surround the town. It has some trade in wine, cheese, hemp, and leather. Pop. (1901) 7,875.

Aoudad, ä'oo-dăd, or **Arui,** a somewhat goat-like wild sheep (*Ovis tragelaphus*), inhabiting the Atlas Mountains of northern Africa. It is about three feet in height, and its horns, which resemble those of the bharal (q.v.), are about two feet long. It is especially characterized by the long whitish hair depending from the throat, chest, and forelegs, but elsewhere its coat is short and light brown, enabling it to hide easily among the rocks of its mountain home. Many other names are given to it, as «ruffed moufflon,» «bearded argali,» «kebsh» (Egypt), «tidal» or «teybal,» and «beden» (Nubia). It is a common resident in menageries, where it breeds readily.

A'oul, the finest of the Somaliland gazelles (*Gazella sœmmerringi*), with massive lyrate horns. Its height is about 30 inches, and the borders of the ears and face are strikingly marked with black.

Apache, a-pä'chē (Pima, «enemy»), the name of a large Indian tribe of the Athapascan stock, kindred to the Navajos, and originally occupying the region from central Texas to the Colorado River in Arizona. The Spaniards applied the name, borrowed from the Pimas, to all the races just north of Mexico, whom they classed as Apachés de Xila, Apachés de Navajo, and Apachés Vaqueros, the first-named being our Apaches. When the United States by the Gadsden Purchase (q.v.) first came in contact with them they numbered about 10,000 and had long been at mortal feud with the Mexicans. For a few years they gave the Americans relatively little trouble of an acute kind, but after a serious raid in 1857 it was urged by those with knowledge that they should be settled north of the Gila, taught industries, and watched. This was not done, however, and in 1860 the whole tribe went on the warpath. The next year the Civil War caused the troops to be withdrawn, and in a short time the Apaches had murdered or driven out every white inhabitant of the Arizona Territory except a few hundred who took refuge in Tucson. For nearly 10 years the Territory was the scene of one of the most awful Indian wars in history, which practically stopped all progress there. On the Indian side it was entirely an affair of ambushes or of sudden raids from mountain strongholds, with burning and slaughtering, and carrying off of captives to be mutilated or outraged and then tortured to death. About a thousand men, women, and children perished.

Military operations were repeatedly stopped for a considerable period by the government commissioners, who wished to institute a policy of kindness, but finally Gen. George H. Crook was allowed to proceed without interruption in 1872-4, and put an end to the operations of the bands as a whole in 1874. But the government policy of concentrating them all on one reservation at San Carlos, Arizona, had unfortunate results. They objected to live with other bands with whom they were as much at feud as with the whites, and also to leave their chosen districts once given them by the government; but both Gen. Crook and his successor, who opposed the transfers, were removed to other departments. Again and again the bands escaped while being removed, and renewed their outrages; and for six years more there was a succession of bloody raids which swelled the total of horrors in the unfortunate Territory and New Mexico. In 1882 Crook was restored, and by tact and their confidence in him induced about 1,500, or over a fourth of them, to live on the reservation without rations. But the rest liked their life much too well to give it up; repeatedly they surrendered and returned with Crook only to break their promise and return to the warpath. The last time was in March 1886, when they escaped before entering Arizona and continued their outrages along the border for five months. The uproar against Crook for being duped (he had upheld the essential justice of their cause, and his belief in their willingness to behave, against the people) caused his replacement by Gen. Nelson A. Miles, who finally cornered the band and forced it to surrender. But the attempt to settle the Chirichuas and Hot Springs bands — the fiercest Indians on the continent, according to Gen. Crook — on a reservation in Arizona roused such a storm of protest from Arizonians that they were removed to Florida instead, then to Alabama, and finally to Fort Sill, Oklahoma, where they still remain, to the number of some 300. In all there are now about 5,200 Apaches. The name is sometimes applied to the Jicarillas, Mescaleros, and Lipans by reason of linguistic affinities; but incorrectly. See Bancroft, 'Native Races of the Pacific States,' Vol. XVII., 1880.

Apalachee, äp-a-lä'chē, or **Apalachi,** a tribe of Indians of the Muskhogean stock, first mentioned in 1526 as occupying the territory about Apalachee Bay and St. Mark's River in northwestern Florida and northward to the mountains to which they have given their name. Near the end of the 16th century Spanish Franciscan friars founded missions among them, till the war of the Spanish Succession, a century later, when the Spanish attempted to use the Indians as allies against the English Carolinas. Twice before the Spaniards had invaded Carolina from St. Augustine; and now, in 1702, they headed a party of 900 Apalachees and marched into Georgia. The Creeks, who were friendly to the English, not only warned them, but a party of 500 ambushed the Apalachees and routed them with great slaughter. The Carolinians determined to take the offensive: and after a fruitless expedition to St. Augustine in December 1703 one was undertaken into the Apalachian territory, which supplied that city with provisions and contained many Spanish forts. With 50 white men and 1,000 Creeks its leader stormed one fortified town and won a sharp battle, capturing several hundred Indians with women and children. Five other towns surrendered unconditionally, while a powerful cacique capitulated for his own safety. The expedition returned in March 1704 with 100 Indian slaves and 1,300 free Indians, who were settled among the Creeks. Twice more within the next four years Carolina invaded this territory with such results that in 1708 it held 850 Indian slaves in addition to what had been given to the Creeks. The Apalachees were thus practically obliterated; and though for a time they maintained their individual existence they finally became merged with the Creeks. See McCready, 'History of South Carolina Under the Proprietary Government' (1897).

Apalachee (ä'pa-lä'chē) **Bay,** a large arm on the south coast of Florida, in the Gulf of Mexico, having a breadth of about 90 miles and an extent inland of 50 miles. At the mouth of the St. Mark's River, which flows into the bay, is the town of St. Mark's.

Apalachicola, ä'pa-lăch-ĭ-kō-la, Fla., city, port of entry and county-seat of Franklin County, on Saint George Sound, Gulf of Mexico, at the mouth of the Apalachicola River; 85 miles southwest of Tallahassee; on the Carrabelle, Tallahassee & Georgia Railroad, and the following lines of steamships: Plant; People's; Merchants and Planters'; Gulf Navigation Co.; Central Gulf Coast Co.; and the Apalachicola and Chipola River line. The city has an important trade in timber and naval stores. The value of its foreign commerce in 1901 amounted to $370,000, the most of which was in export trade. The city has one national and several private banks. Pop. (1890) 2,727; (1900) 3,077.

Apalachicola, a river flowing from southeastern Georgia across Florida, and entering the Gulf of Mexico through Apalachicola Bay. It is navigable throughout its length of 90 miles and is formed by the union of the Flint and Chattahoochee Rivers.

Ap'anage, or **Ap'panage,** an allowance formerly received by the younger princes of a reigning house in which the right of primogeniture prevailed, from the revenues of the country. It consisted mostly in money, with the use of a residence and hunting grounds, attended frequently with the right of jurisdiction over these domains.

Apar, ä'pär, the three-banded armadillo (*Tolypeutes tricinctus*), which has three movable bands and is one of the small species able to roll itself into a ball. See ARMADILLO.

Aparri, a-pär'rē, Philippines, a town of the Cagayan province, on the river Cagayan, near its mouth. Pop. 11,265.

Apart'ment House, the term used in the United States to designate a structure intended to accommodate several families, each in its own set of rooms, which form a separate dwelling. Such structures are of comparatively recent introduction, but houses of this kind have long been built in Europe. In New York and other American cities there are now great blocks of such houses, which provide excellent and commodious dwellings at a lower rent than if

each were a separate building. See ARCHITECTURE (*American*).

Apat'elite (from the Greek *apatelos*, "deceitful"), a mineral related to raimondite, occurring in small yellow, friable nodules in the immediate vicinity of Paris, France. It has the probable composition $4Fe_2O_3.6SO_3.3H_2O$.

Ap'atite (from the Greek word *apate*, "deceit," in allusion to the fact that apatite is often confused with other minerals), a native phosphate of calcium, combined with fluorine or chlorine, and crystallizing in the hexagonal system, though also occurring massive. The crystals have a specific gravity of about 3.2 and a hardness of 5. Apatite is usually green, but it may occur white, or strongly red, yellow, brown, or blue. The common variety has the formula $(CaF)\ Ca_4(PO_4)_3$, and is known as "fluor-apatite"; but the fluorine is sometimes replaced to a considerable extent, or even wholly, by chlorine. In such cases the mineral is known as "chlor-apatite." A variety called "mangan-apatite" is also known, in which the calcium of the typical mineral is partially replaced by manganese. Apatite is widely distributed, and in many places occurs in vast deposits which are worked on a commercial scale on account of the value of the mineral as a phosphatic fertilizer. The Canadian apatite occurs massive or in large crystals. It was formerly extensively mined as a fertilizer, but its use has now been almost entirely supplanted by the "rock phosphate" of Florida, South Carolina, and Tennessee. See FERTILIZERS.

Apatite Group.— In mineralogy, a group of minerals crystallizing in the hexagonal system, and consisting of arsenates, phosphates, and vanadates of calcium and lead, associated with chlorine or fluorine. It contains apatite, pyromorphite, mimetite, vanadinite, hedyphane, pleonectite and svabite.

Ape (A. S. *apa*, Ger. *Affe*), in modern usage, a term describing an Old-World tailless monkey, such as the gorilla, orang-utan, chimpanzee, or gibbon, but originally an exact synonym for monkey and applied to any quadrumanous animal except the lemurs. For examples of this older usage see BABOON; MACAQUE; MONKEY. In its modern sense it applies particularly to the family *Simiidæ*, or anthropoid apes, found in the forests of the equatorial regions of the Old World and called "anthropoid" on account of their great resemblance to man. This likeness is especially marked in young individuals before the face has attained its full brutality of expression, the canine teeth their great size, and the skull its final thickening and growth into crests and ridges. Except for the shape of the jaw (which, instead of being curved, comes to a noticeable angle on each side with a canine tooth at the apex of each angle), and for the development of the skull already mentioned, as well as for the relative length of the arms and shortness of the legs, and the fact that the great toe is short and more or less opposable to the other fingers, an ape's skeleton is practically the same as man's, though larger and heavier in proportion to the body, and lacking certain curvatures of the spine which adapt the human frame to ease in an erect position. The brain-case, and the brain itself are much smaller than in man, yet similar in development, and the brain is much convoluted. The teeth are of the same number as man's and of like character. In certain divergences of structure exhibited between the inferior families of monkeys and man, the ape resembles man and differs from the monkeys.

The gibbons (noticeable for standing erect with less difficulty than any other apes), the chimpanzee (which has the largest brain), the gorilla, and the orang-utan, together with several extinct and fossil species, make up the anthropoid apes. All are clothed with hair on all parts of the body except the face and palms; they have no cheek-pouches, no tail, and either no trace or but very slight traces of the naked spots or callosities seen upon the buttocks of the lower apes. All are as large or larger than man, and all can walk upright, though they are more at ease in climbing than in walking. When on the ground they make their way slowly, sometimes closing the hands in order to walk on the knuckles instead of the palm, and either similarly closing the foot or walking on its side. Their food is mainly vegetable, yet their great strength, their intelligence, and their savage nature, place them among the most dangerous of wild animals. See CHIMPANZEE; GIBBON; GORILLA; ORANG-UTAN; PITHECANTHROPUS.

Ape'ga, the wife of Nabis, a tyrant of Sparta, who invented an infernal machine which he called after his wife, "Apega." It was a box exactly resembling his wife in her royal apparel, but the interior was full of spikes which wounded the victim enclosed in almost every part of the body. The "Iron Virgin" was a similar instrument employed by the Inquisition. It represented a woman of Bavaria, and the spikes were so arranged as to pierce the least vital parts in order to prolong the sufferings of the victim enclosed.

Apel, ä'pĕl, **Johann August**, a German author: b. in Leipsic, 1771; d. 1816. His 'Gespensterbuch' and 'Wunderbuch' were both popular, the former containing the bases for the text of Weber's opera of 'Der Freischütz. His 'Metrik,' which includes a survey of ancient prosody, is his best-known work.

Apeldorn, ä'pĕl-dôrn, or **A'peldoorn**, a notably attractive town of Holland, province of Guelderland, 17 miles north of Arnhem; with manufactures of paper, morocco leather, and copper-plates. The Loo, a favorite palace of the late king of Holland, is at Apeldorn. Pop. (1900) 25,761.

Apel'les, the most famous painter of ancient Greece and of antiquity: b. in the 4th century B.C., probably at Colophon. Attracted by the renown of the Sicyonian school, he studied at Sicyon. In the time of Philip he went to Macedonia, and there a close friendship between him and Alexander the Great was established. The most admired of his pictures was that of Venus rising from the sea and wringing the water from her dripping locks. His portrait of Alexander with a thunderbolt in his hand was no less celebrated. His renown was at its height about B.C. 330, and he died near the end of the century. See Houssaye, 'Histoire d'Appelles' (1867); Wustman, Apelles' Leben und Werke' (1870).

Ap'ennines, the chief mountain range of Italy, about 800 miles long and 25 to 85 miles wide, extending from Savona to Reggio in the

form of a bow. Geologically the Apennines resemble the Alps, and connect them with the north Sicilian and north African mountain ranges. Granite and crystalline schist (gneiss and mica-schist) are found in the Ligurian Apennines, especially in Calabria, south of the Gulf of Policastro. In the Apennines proper these older crystalline formations are entirely lacking. They consist principally of limestone, dolomite, sandstone, and marl, of the Chalk and Tertiary formations, in which occur strata of serpentine in the north, and sometimes trachyte and basalt, especially on Mount Vulture. In the northern Apennines, and also in the Tuscan highlands, there are large quantities of marl, shale, and blue-gray sandstone, which belong in part to the Chalk formation and in part to the early Tertiary. Limestone is found in large quantities in the composition of the whole mountain range. Carboniferous, Permian, Triassic, and Liassic deposits occur in the Apuan Alps, the famous marble of Carrara belonging to the Liassic or Triassic period. The Apennines are divided into six parts, according to the regions through which they pass, and these fall into three groups, the northern Apennines (including the Ligurian and Etruscan); the middle Apennines (the Roman Apennines and the Abruzzi); the southern Apennines (the Neapolitan and Calabrian). The Ligurian Apennines reach from the Col de Tenda, the geological boundary of the Alps, to the Pass of Cisa (about 700 miles). The southern slope falls abruptly to the sea, the northern slope gradually, with many valleys, toward the river Po. Numerous passes lead from the coast towns over the range, among them the Bochetta Pass, and the Giovi Pass from Genoa; and the Genoa-Alessandria Railroad has cut a tunnel through near the last-named pass. From there to the east the range almost doubles its width and increases in height. The eastern half, consisting of several parallel chains, is difficult to cross, and a serious hindrance to transportation. In this portion there are practically no thoroughfares except the railroad from Parma to Spezia.

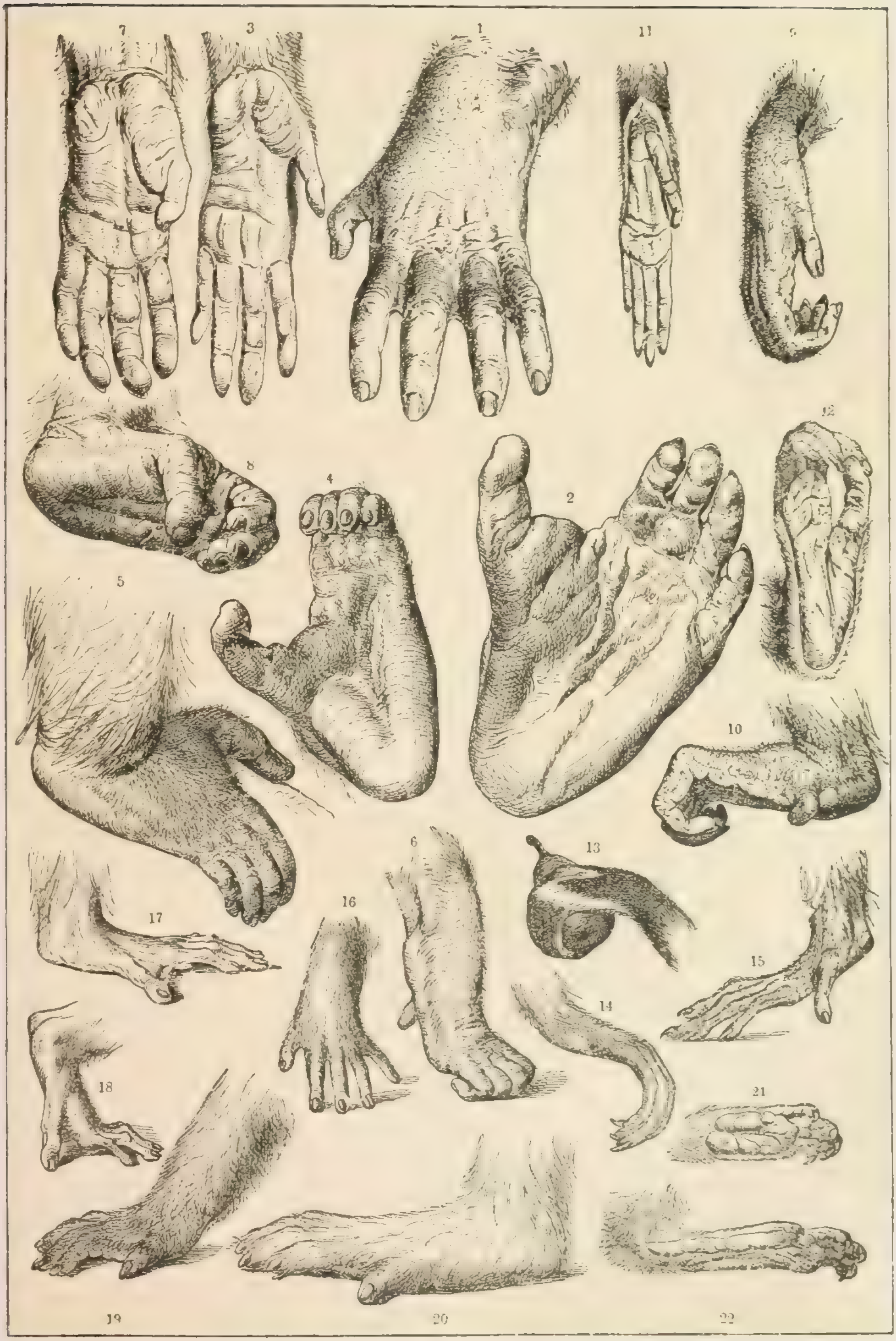
The Etruscan Apennines, extending to the valley of the Metauro, have a southeasterly direction throughout and consist of several ranges, one in front of the other, like the links of a chain. The most noted peaks are in the northern part, the Alpe de Succiso (about 6,600 feet), Mount Cusna (over 6,900 feet), and Mount Cimone (7,103 feet), the latter being the highest peak in the northern Apennines. The northern portion includes the Apuan Alps, bounded by the valley of the Serchio, the Magra and the Antella, which reach the height of about 6,400 feet in Mount Pisano and are of pure marble (Carrara) on the slope toward the sea. The most important thoroughfare of the Etruscan Alps is the railroad from Bologna to Florence, which passes through a tunnel near Prachia; the La Fluta Pass, over which the road from Florence to Bologna passes, should also be mentioned. The Roman Apennines, beginning between the valleys of the Tiber and the Metauro, extend to the valley of the Tronto and Belino and consist of numerous parallel chains. In the north the main peak is Mount Catria (about 5,420 feet); in the south, the chain of the Sybilline Mountains rise to the height of 5,100 feet (Mount Vittore). The formation of the range here renders the crossing easy, and the railroad from Ancona to Florence and Rome crosses here. The Abruzzi extend southward from the valley of the Tronto, and in their eastern chain in Gran Sasso' d'Italia reach the greatest height in the whole Apennines (Mount Corno, 9,585 feet). The western chain, which, with the eastern, encloses the Plain of Aquila, has a height of almost 8,150 feet (Mount Velino), and south of the Pescara tunnel is the Majella range with a height of 9,200 feet. The Neapolitan Apennines extend from the valley of the Sangro and Volturno to that of the Crati, but their altitude is much less than that of the middle Apennines, the Matesian Mountains reaching the height of over 6,700 feet in Mount Miletto. Rounded, wave-like shapes prevail in this range. On the eastern range is the extinct volcano of Mount Vulture. The roads and railroads from the west to the east coast encounter no particular difficulty in crossing this range. In the south the Apennines reach again a noticeable height in Mount Pellino (7,450 feet) and slope abruptly to the valley of the Crati. The Calabrian Apennines consist of a small chain sloping abruptly to the Tyrrhenian Sea, and of the granite plateau of the Silagian Mountains with a mean height of 3,000 feet. This North Calabrian mountain land is separated from the South Calabrian by a neck of land between the Gulf of Santa Eusemia, and the Gulf of Squillace. The outer northerly and northeastern slope of the Apennines is gradual, the eastern slope almost everywhere so abrupt that on the Adriatic coast there is only room for a road. Since the Apennines on the west of the Gulf of Salerno lie near the coast, but in the north extend farther and farther away from it, there exists a three-cornered space in which lie the so-called Lower Apennines. The volcanic formation is especially characteristic of these mountains, and these regions are the classic ground of present and former volcanic action. Therefore there are here active and extinct volcanoes and hot springs, among them the springs of Voltena. The Lower Apennine region is divided into several parts by the broad valleys of the rivers flowing from the Apennines. Of these divisions the Tuscan highland is the most noted, ending on the south at the lower Tiber. In the interior are fertile plains sloping gently toward the valley of the Arno; in the west the highlands end with an abrupt slope, between which and the coast lie the plains of Maremma, from which rise a few single peaks. The part of the Lower Apennines between the valleys of the Tiber and the Garigliano includes two small mountain-groups: the Alban Mountains, famed for their beautiful scenery, and the Volsker Mountains extending as far as the coast near Terracina. West of these Volscian Mountains lies a plain whose northern portion includes the Campagna of Rome, while the southern part contains the Pontine marshes. The southernmost part of the Lower Apennines extends from the Garigliano to the mountain range of Castellamare, north of Salerno, and includes the plain of Campania, noted for its fertility as well as its beauty. From this plain rise several single volcanoes, including the extinct Mount Della Croce in the north and Vesuvius (4,200 feet) in the south. The climate is on the whole more severe than would be expected from the latitude and the position of

CHIMPANZEE (*Anthropopithecus niger*)

APES AND MONKEYS.

Fig. 1 Skeleton of young Orang-outang. 2 Chimpanzee. 3 Skull of young Chimpanzee. 4 Skull of old Gorilla. 5 Skull of young Gorilla. 6 Kahau or Proboscis Monkey. 7 Mona Monkey. 8 Magot or Barbary Ape. 9 Mandrill. 10 Head of Baboon. 11 Black Howler. 12 Coaita. 13 Capuchin Monkey. 14 Night Monkey. 15 Marmoset.

HANDS AND FEET OF APES.



1–2.	Gorilla.	14–15.	Guereza.
3–9.	Chimpanzee.	16–18.	Barbary Ape.
10.	Orang-Utan.	19–20.	Dog-faced Baboon.
11–13.	Gibbon.	21–22.	Night Ape.

Italy, while the heat in summer reaches a degree almost unendurable in the low and sheltered valleys, and palms and other tropical vegetation can thrive on almost all the west coast; neither fruit nor grain grow on the exposed, windy heights, with their elevation of over 3,000 feet, and the trees are few and stunted. The region of vegetation may be divided into four sections: (1) The olive region to the 1,500-foot elevation, with Mediterranean flora, garden plants, and winter pasturage; (2) the region of the chestnut and oak, to the elevation of 3,000 feet, with agricultural products and chestnut woods; (3) the region of the beech and coniferous trees at the height of 3,000 to 6,000 feet; (4) the region of the shrubs and Alpine plants with summer pasturage extending to the highest peaks. In climate, therefore, the northern Apennines form a line of separation between north and south; only on their southern slopes does Italy really begin. The northern part only presents great difficulties in traveling. The mountains are now traversed by eight railroads, mostly by means of tunnels.

Apenrade, ä'pĕn-rä'dĕ. (Danish, *Aabenraa*), a seaport of Prussia, in the district of Schleswig-Holstein, on the Little Belt and in the Bay (fjord) of Apenrade. It is beautifully situated in a deep valley surrounded by woody heights and a fertile country. Apenrade has a school of navigation and carries on a considerable seafaring trade. It is a popular bathing resort and is a place of considerable antiquity. Pop. (1900) 6,616.

Ap'erture, in anatomy, zoology, botany, etc.: The aperture of a univalve shell is the opening or mouth. In mollusks which feed on vegetable matter it is entire; while in those which are animal feeders it has a notch or canal. In some families it has an operculum or cover. The margin of the aperture is called the peristome.

In optics, see MICROSCOPE; TELESCOPE.

Ape's Hill (Arabic, *Jebel Zatut*), the ancient Abyla, the extremity of a mountain range in northern Morocco, opposite Gibraltar, and one of the «Pillars of Hercules.»

A'pex, in mining, the highest point of outcrop of a mineral vein or lode. This is the common definition of the term as used by miners, although its legal significance must be interpreted in connection with the local conditions and cannot be defined in general terms. According to the Revised Statutes of the United States for 1872 the owner of a mineral claim which includes the apex is allowed to follow the vein along the dip for an indefinite distance without regard to the ownership of the overlying surface, so that the proper location of the apex is of the utmost importance in establishing the lines for a claim. It has been decided by the courts that the apex need not appear necessarily at the surface, and hence the term does not exactly coincide with the term outcrop. In the case of an inclined vein whose apex is concealed, but which outcrops at some point lower down, the right of mining is conveyed to the owner of the apex-claim in preference to the owner of the outcrop-claim. This law has been the cause of much confusion and of expensive litigation in settling the ownership of valuable mining properties in the western States. A wiser provision is that obtaining in most European countries, which grants the owner the right of mining only within the vertical limits of his claim.

Apex of the Sun's Way, a term signifying the point in the constellation Hercules to which the sun's motion in space is directed. This point is about in right ascension 18 hours 30 minutes, and declination 35° north. The point is therefore somewhat south of the zenith for most of the United States in the early part of the evenings of August. Of course this statement is meant to indicate the locality only in the most general way. That the solar system is moving toward this part of the heavens is indicated by the apparent spreading apart of the stars in this region, together with an apparent crowding together of the stars in the opposite direction, as the trees open in front of one walking through a grove and shut together behind him. The velocity of this motion is shown by spectroscopic observation to be about 11 miles per second. The movement, so far as observed, seems to be in a straight line, but may turn out to be in a vast curved orbit.

Aphan'esite, a-fan'e-sīt (from the Greek *aphanes*, «obscure,» in allusion to the difficulty of recognizing it by its crystals), a mineral now better known as CLINOCLASITE.

Aphanip'tera, an order of wingless insects having a sucker of three pieces and a true metamorphosis. The thorax is distinctly separate from the abdomen, and two horny plates mark the spots where wings would be in the higher insects. It contains the *Pulicidæ*, or fleas.

Aph'anite, ăf'ă-nīt (derivation same as for aphanesite), a variety of the rock known as diorite, in which the constituent minerals occur in such small grains that the aggregate rock appears almost (or quite) homogeneous, except when examined through a lens.

Aphasia, the designation of a disorder of speech due to disturbance of its brain mechanism independently of any muscular defect. This mechanism is complex and is usually divisible into two parts, the receptive, or sensory, and emissive, or motor. To the former belong those parts of the brain that store concepts of spoken words or written words; to the latter those parts concerned in co-ordinate speech or in writing. Thus aphasia may be of at least four different and independent types. Frequently it is a combination of one or more of these. The centre in the brain that stores intellectual auditory impressions is located in the first temporal convolution. Any injury to this part of the speech mechanism may produce auditory aphasia, or word deafness. A patient thus affected is able to hear words and to speak, but he does not comprehend what is being said to him. He has lost his hearing word memories, and his own language is as a foreign language that he hears but cannot comprehend. In an analogous manner, if there is disorder of the occipital lobes, about the calcarine fissure, or of its related fibre tracts, a patient may have visual aphasia, or word blindness. His own written

language might as well be in Arabic, for he has lost all his memory of written words. These types of aphasia are much less common than the true type of motor aphasia, or aphemia. In this the trouble is in the third left frontal convolution in the brain, Brocas convolution, or its related fibre tracts, and a patient thus affected has lost the power to say the words he desires to say. He is perfectly able to talk, may repeat words, but knowing in his mind precisely what he wishes to say is unable to express it, not because of any failure of the muscular power of the tongue to articulate, but because of the defect in the storage centre or its fibre paths for motor speech. A fourth type is *agraphia*, in which the affected patient is unable to write with understanding the words with which he is familiar. The site of the lesion here is undetermined. It usually accompanies motor aphasia. There are also forms of combined aphasia in which the fibre tracts from one centre to another are cut off. These make paraphasias, and their symptoms are extremely complex. Aphasia in its various forms may differ very widely in its extent. It may be very slight or very profound. It may be temporary or permanent, depending on the nature and extent of the brain injury. Aphasia is most frequently a symptom of hemorrhage from some artery or arteries in the brain; it may be caused by the growth of a tumor or result from an injury. The treatment is that of the causing disease. In the sensory aphasias education of the non-affected areas is of great importance. If there is word blindness, the memory for spoken symbols should be cultivated, and *vice versa*. See SPEECH, DEFECTS OF.

Bibliography.— Baldwin, 'Dictionary of Philosophy and Psychology,' article entitled 'Speech and its Defects' (1903); Collins, 'The Genesis and Dissolution of the Faculty of Speech' (1898); Bastian, 'Aphasia and other Speech Defects' (1898); Elder, 'Aphasia and the Cerebral Speech Mechanism' (1897) (with bibliography); Küssmaul, article in 'Ziemssen's Encyclopedia of Medicine,' Vol. XII.

Aphe'lion, that part in the orbit of the earth (or any other planet) which is farthest from the sun.

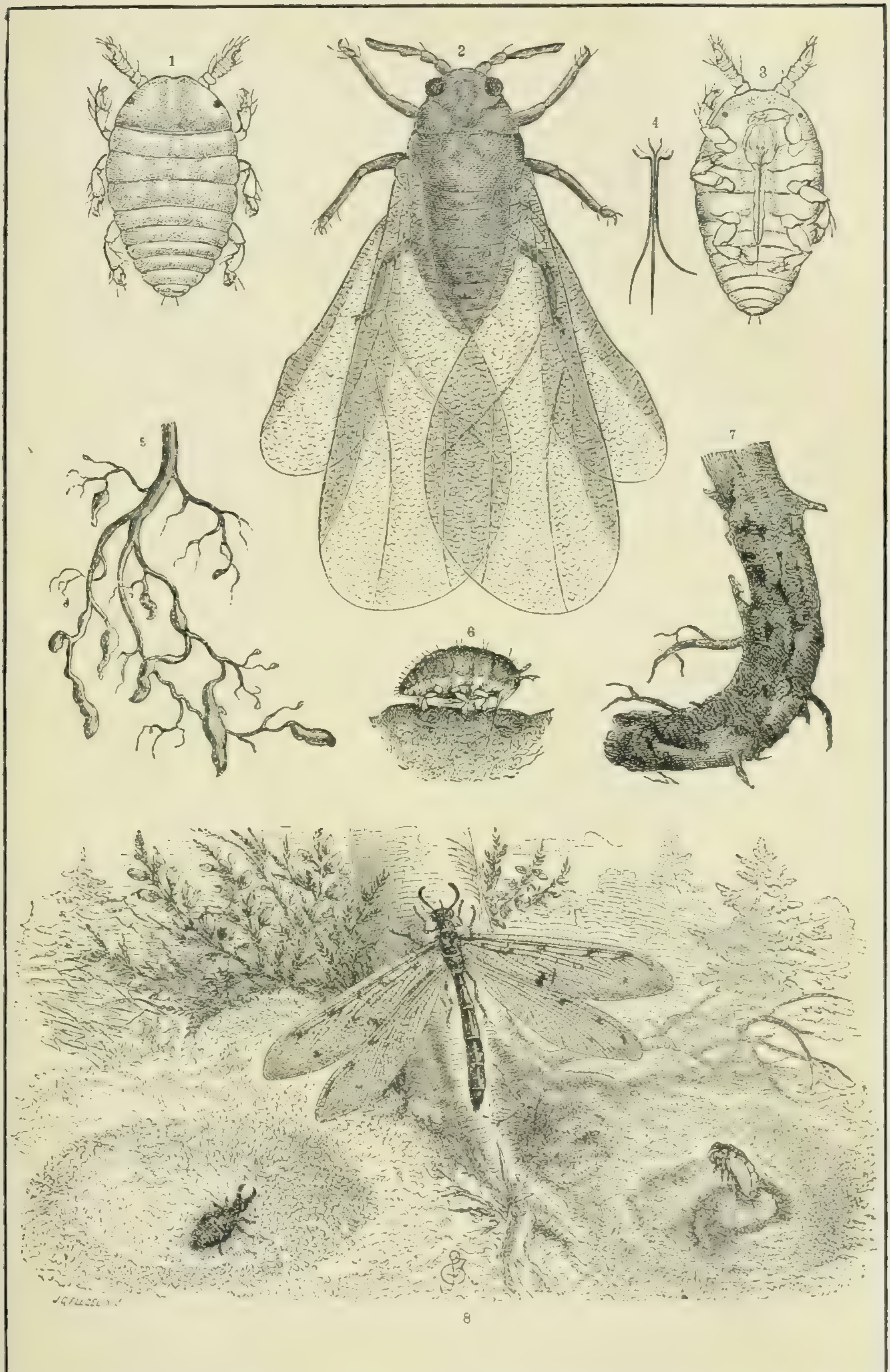
Aphemia, a term employed to designate a motor aphasia. See APHASIA.

A'phis, a plant-louse of the family *Aphididæ,* order *Hemiptera.* Aphides are among the most abundant of insects and do much injury to vegetation by their habit of sucking the sap of leaves and stems of plants. They are usually very small, never over a quarter of an inch in length. Their mouth-parts form a slender beak adapted for puncturing leaves and sucking the sap. Their antennæ are from five- to seven-jointed, and generally longer than the body. The ocelli are wanting, and the beak is three-jointed and developed in both sexes. The legs are long and slender, with two-jointed tarsi. The males and females are winged, and also the last brood of asexual individuals, but the early summer broods are wingless. Their bodies are flask-shaped, being cylindrical, the abdomen thick and rounded, and in aphis and lachnus provided with two tubes on the sixth segment for the passage of a sweet fluid (honey-dew) secreted from the stomach, which attracts crowds of ants. (See ANT.) The wings are not net-veined, having few veins, which pass outward from the costa. They are usually green in color, with a soft powdery bloom exuding from their bodies. Bonnet first discovered that the summer brood of wingless individuals were born of virgin parents, hatched from eggs laid in the autumn, and that the true winged sexes composed the last generation, which united sexually, and that the female laid eggs in the autumn which produced the spring brood of asexual wingless individuals.

In the early autumn the colonies of plant-lice are composed of both male and female individuals. These pair, the males then die, and the females begin to deposit their eggs, after which they die also. Early in the spring, as soon as the sap begins to flow, these eggs are hatched, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the whole brood, without a single exception, consists solely of females, or rather, and more properly, of individuals which are capable of reproducing their kind. This reproduction takes place by a viviparous generation, there being found in the individuals in question young lice which, when capable of entering upon individual life, escape from their progenitors and form a new and greatly increased colony. This second generation pursues the same course as the first, the individuals of which it is composed being, like those of the first, sexless, or at least without any trace of the male sex throughout. These same conditions are then repeated, and so on almost indefinitely, experiments having shown that the power of reproduction under such circumstances may be exercised, according to Bonnet, at least through nine generations, while Dural thus obtained eleven generations in seven months, his generations being curtailed at this stage not by a failure of the reproductive power, but by the approach of winter, which killed his specimens. Huber observed that a colony of *A. dianthi,* which had been brought into a constantly heated room continued to propagate for four years in this manner without the intervention of males, and even in this instance it remains to be proved how much longer these phenomena might have been continued.

Certain species feed on the roots of plants, as asters, lettuce, grasses, etc., and these also attract numerous ants. The cornplant-louse has been found by Forbes to hibernate in the wingless, asexual form in the earth of previously infested corn-fields. In the spring an ant (*Lasius alienus*), which runs its tunnels along the principal roots of the corn, collects the aphides and conveys them into its galleries, where they are watched and protected. The white-pine aphis (*Lachnus strobi*) is destructive to young white-pine trees. Another aphid is the grape *Phylloxera* (q.v.). The woolly aphids (*Schizoneurà tessellata*) flock on the stems of the alder, their bodies concealed by a flocculent mass of wax. Another destructive species is the apple woolly louse (*S. lanigera*). Aphides can be exterminated by frequent spraying.

APHIS AND ANT-LION.



1-7. Phylloxera Vastatrix.
1-3. Larvæ, Front and Back View.
2. Adult Insect.
4. Mouth Parts.
5. Grape Vine Root in which the Insects are working.
6. Larva, Side View.
7. Old Root, with Colonies of Lice.
8. Ant-Lion (Myrmeleon formicarius). Showing Pupa, Larva and Adult Stages.

Bibliography.— Works on injurious insects and economic entomology, especially, for the United States, Thomas, 'Eighth Report of State Entomologist of Illinois' (Springfield, 1879); and for Europe, Buckton, 'Monograph of British Aphides' (Ray Society, London, 1879–83).

A'pis (Egyptian. *Hapi*), a bull at Memphis to which divine honors were paid by the ancient Egyptians, and which was regarded as the representative of Osiris. It was necessary that he should be black, with a triangle of white on the forehead, a white spot in the form of a crescent on the right side, and a sort of knot like a beetle under his tongue. Other marks are also mentioned. When a bull of this description was found he was fed four months in a building facing the east. At the new moon he was led to a splendid ship with great solemnity, and conveyed to Heliopolis, where he was fed 40 days more by priests and women, who performed before him various indecent ceremonies. From Heliopolis the priests carried him to Memphis, where he had a temple, two chambers to dwell in, and a large court for exercise. His actions were thought to have prophetic significance, and he was believed to impart prophetic power to the children about him. His birthday was celebrated every year, when the Nile began to rise. The festival continued for seven days, and it was said that the crocodile was always tame as long as the feast continued. Notwithstanding all this veneration, the bull was not suffered to live beyond 25 years, the reason of which is probably to be found in the astronomical theology of the Egyptians. The death of Apis, however, excited universal mourning, which continued till the priests had found a successor to him. As it was extremely difficult to find one with all the above distinctions, fraud was often practised by the priests.

Ap'johnite, a native manganese alum, or hydrated sulphate of aluminum and manganese, found in fibrous form and as incrustations at Lagoa Bay, South Africa, and in Sevier County, Tennessee. It is variable in composition, but some analyses indicate $MnSO_4.Al_2(SO_4)_3 + 24H_2O$. It is usually white or nearly so, and tastes much like common alum.

Aplanatic Lenses, a term applied to lenses nearly or quite free from spherical aberration. If the curved surfaces of a single convex lens are portions of spheres, the rays of light from one point of an object are not accurately brought together at one corresponding point of the image, the rays passing through the outer portions of the lens being too much refracted. The result is a distorted image. Theoretically it is easy to correct this error by substituting ellipsoidal surfaces for the spherical, but such surfaces cannot be accurately constructed. Spherical aberration is corrected, in practice, by combinations of two or more lenses in one, the surfaces being of differing curvatures. The results are quite satisfactory, and the method is applied in the manufacture of objectives and eye-pieces for telescopes and microscopes, as well as in the making of lenses to be used in photography.

Apoc'alypse (Greek, *apokalypsis*, from *apokalyptō*, I reveal), the name frequently given to the last book of the New Testament. It is generally believed that the Apocalypse was written by John in his old age, at the end of the first century (95–97 A.D.), in the Isle of Patmos, whither he had been banished by the Roman emperor Domitian. Though commonly regarded as genuine in the first centuries of Christianity, critics have not been wanting who have doubted the evidence of its being the work of St. John. Its genuineness was maintained by Justin Martyr (c. 150), Irenæus (195), Clement of Alexandria (200), Tertullian (207), and many others; and doubted by Dionysius of Alexandria (240), Cyril of Jerusalem, Chrysostom, and, nearer our own times, by Luther and a majority of eminent German commentators. In recent times a composite authorship has been suggested and some have regarded it as a Jewish work adapted by a Christian writer. The Apocalypse, on account of its metaphorical language, has been explained differently by almost every interpreter, and for the same reason it has furnished all sorts of sects and fanatics with quotations to support their creeds or pretensions. There can be no doubt that the hopes of the early Christians and the severe persecution they endured led them to regard the Roman empire as the object of prophetic denunciation, and the coming of Christ and the millennium as near at hand. When, under Constantine, however, the Christians became dominant and prosperous, the empire was considered as the scene of a millennial development, and in course of time the barbarous hordes who were closing round Rome were regarded as fulfilling the woes predicted in the Apocalypse. At the Reformation the Protestants identified Babylon with papal Rome, and the second beast of Antichrist with a universal pontiff. The modern interpreters may be divided into three schools: namely, the historical school, who hold that the prophecy embraces the whole history of the Church and its foes from the time of its writing to the end of the world; the Præterists, who hold that the whole, or nearly the whole, of the prophecy has been already fulfilled, and that it refers chiefly to the triumph of Christianity over Paganism and Judaism; and the Futurists, who throw the whole prophecy, except the first three chapters, forward upon a time not yet reached by the Church — a period of no very long duration, which is immediately to precede Christ's second coming. The Apocalypse contains 22 chapters, which may be divided into two principal parts. The first comprises "the things which are"— that is, the then present state of the Christian Church, including the epistolary instructions and admonitions to the angels or bishops of the seven churches of Ephesus, Smyrna, Pergamos, Thyatira, Sardis, Philadelphia, and Laodicea, situated in Asia Minor. The second part comprehends a prediction of "the things which shall be hereafter," referring either to the future state of the Church through succeeding ages, from the time of the apostle to the grand consummation of all things, or to the state of the souls of men after the general resurrection.

Apocalyptic Literature, the designation of a large body of literature originating in Jewish and continued in early Jewish Christian circles. The most of it was produced between 200 B.C and 200 A.D. In a broad sense it had for its theme the future triumph of the kingdom of God. The most important works were written in times of great stress, when persecution or

oppression weighed heavily on the Jews (or Christians, as the case might be). At such times consolation was found in the thought that God would surely cause his kingdom to triumph by punishing the wicked and rewarding his saints.

The beginnings of Apocalyptic literature are to be found in the Old Testament writings of the Exile period. The main theme of the prophetic messages of these times was, of course, the solution of the problems directly concerned with Israel in exile, and the teaching was mainly in the nature of rebuke for sin, instilling loftier and purer conceptions of God and sustaining the hope of a restoration to the old land, there to enjoy a long and happy existence. But at times the future unveiled by prophecy took on a peculiar aspect,— on an imaginary arena, in an undated distant time, the great forces of the world and of God were seen to be in conflict. At first, as in Ezekiel xxxviii. and xxxix., the scene of the struggle is this earth, and the doom of the defeated hosts is simply their destruction by slaughter. The same may be said of the apocalyptic strains in Zech. xiv. and Joel iii. 9–21. It is this unveiling of the future, not as to single events or specific historical movements, but as to its processes and great world-wide and age-long conflicts, that is technically termed *apocalyptic* (from the Greek ἀποκαλύπτειν to unveil). The foundation being thus laid in exilic and early post-exilic days, when the next great crisis came in the deadly struggle with Syria (168–142 B.C.) it was but natural that a gifted spirit should again make use of this form of prophetic instruction. Hence we have in Daniel vii.–xii. such unveilings of the course of history in which the certain triumph of Jehovah's eternal kingdom is the inspiring motive. But now Apocalyptic perception has opened its vision not simply on the earthly phases of the struggle, but on its eternal outcome for the evil and the good (cf. Dan. xii.). Henceforth these phases are to receive special attention from Apocalyptic writers. The book of Daniel gave Judaism a powerful impetus in this direction, and in the succeeding centuries Apocalypses were put forth which made bold to pretend to uncover the secret counsels of God's purposes and the mysteries of heaven and hell. The most refined and purified of all such works is the great Christian Apocalypse of the Apostle John. With the single exception of the New Testament Apocalypse all the works of this nature are pseudepigraphic. In order to give them the appearance of predictions uttered long before the times in which they were actually written they were put forth under the name of some ancient worthy, as Enoch, Abraham, Moses, etc., as though spoken or written by him. Between 20 and 30 Apocalyptic works are known to have been once in circulation. Those of Jewish origin, among which the most influential and comprehensive were the Book of Enoch and 2 Esdras (the latter in the Old Testament Apocrypha) were taken over into Christian circles, and there often recast and made to do service as Christian books. After about 200 A.D. Christian scholars strongly disapproved of the use of the various Apocalypses, except those in the Bible and 2 Esdras, and they gradually dropped out of use. Many are now known only by name.

EDWARD E. NOURSE.

Apoc'alyp'tic Number, the mystic number 666, which, according to some authorities, should be 616, mentioned in Revelation xiii. 18. As early as the second century ecclesiastical writers found that the name Antichrist was indicated by the Greek characters expressive of this number, numbers being expressed in Greek by the letters of the alphabet. By Irenæus the word *Lateinos* was found in the letters of the number, and the Roman empire was therefore considered to be Antichrist. Another solution is *Neron Kesar* (Hebrew form of Nero Cæsar). Omitting the *e's* and the *a*, not written in ancient Hebrew, we get 666 as the value of the letters.

Apochrom'atic Lens. See LENS.

Apoc'rypha (Greek, "things concealed or spurious"), a term applied in the earliest churches to various sacred or professedly inspired writings, sometimes given to those whose authors were unknown, sometimes to those with a hidden meaning, and sometimes to those considered objectionable. It is specially applied to the 14 undermentioned books written during the two centuries preceding the birth of Christ. They were extant, not in Hebrew, but in Greek, and were accepted by Alexandrian, though not by Palestinian Jews. They were incorporated into the Septuagint, and thence passed to the Vulgate, but the Greek Church excluded them from the canon in 360 at the Council of Laodicea. The Latin Church treated them with more favor, and the Council of Trent, in the fifteenth century, definitively declared the acceptance of these books as part of the canon to be of faith. The Anglican Church says they may be read for example of life and instruction of manners, but that the Church does not apply them to establish any doctrine. All other Protestant churches in Great Britain and America ignore them. The following 14 books form the Apocrypha of the English Bible: The first and second Books of Esdras, Tobit, Judith, the rest of the Book of Esther, the Wisdom of Solomon, the Wisdom of Jesus the son of Sirach, or Ecclesiasticus, Baruch the Prophet, the Song of the Three Children, Susanna and the Elders, Bel and the Dragon, the Prayer of Manasses, and the first and second Books of the Maccabees. Besides the Apocryphal books of the Old Testament there are many spurious books composed in the earlier ages of Christianity, and published under the names of Christ and his apostles, or of such immediate followers as from their character or means of intimate knowledge might give an apparent plausibility to such forgeries. These writings comprise: 1st, the Apocryphal Gospels, which treat of the history of Joseph and the Virgin before the birth of Christ, of the infancy of Jesus, and of the acts of Pilate; 2d, the Apocryphal Acts of the Apostles; and 3d, the Apocryphal Apocalypses, none of which have obtained canonical recognition by any of the Churches. See Cowper, 'Apocryphal Gospels, Etc.'

Ap'ocyna'ceæ, the designation of an extensive natural order of monopetalous exogenous plants, characterized by perfectly symmetrical flowers, the segments of the corolla all twisted one way like a catherine-wheel, five distinct stamens, a superior ovarium, which when ripening opens into two parts that diverge from each other at right angles; fruit follicular or capsular, or drupaceous or baccate, double or

single. The order consists of trees or shrubs, many of whose stems yield, when wounded, a copious milk, usually poisonous. Generally found in tropical regions, they appear to be most abundant in the hot parts of Asia, are less common in the tropics of America, and still more rare in Africa. About 100 genera, including 566 species, have been enumerated. The plants of this order are in many cases poisonous, and very generally to be suspected, although in some cases they are used medicinally, and in others have an edible fruit. One of the most deadly plants of the order is the *Tanghina venenata.* The kernel of the fruit, although not larger than an almond, is sufficient to kill 20 men; it was formerly used in Madagascar as an ordeal. The common oleander (*Nerium oleander*) is a formidable poison and death has resulted from eating its flowers.

Apodictic Judgments, a logical term adopted by Kant from Aristotle to distinguish judgments or conclusions which are beyond contradiction from those which are merely empirical; or to put it differently, a judgment or conclusion which is founded on the impossibility of the opposite, not upon grounds of experience is an apodictic judgment.

Apollinarians, a sect of Christians who maintained the doctrine that the Logos (the Word) holds in Christ the place of the rational soul, and consequently that God was united in him with the human body and the sensitive soul. Apollinaris, the author of this opinion, was, from 362 A.D. till about 382 A.D., bishop of Laodicea, in Syria, and a zealous opposer of the Aryans. As a man and a scholar he was highly esteemed, and was among the most popular authors of his time. He formed a congregation of his adherents at Antioch, and made Vitalis their bishop. His teaching was condemned at Alexandria in 362; by Pope Damasus in 375; and in the Council of Constantinople in 381. The Apollinarians, or Vitalians, as their followers were called, soon spread their sentiments in Syria and the neighboring countries, established several societies, with their own bishops, and one even in Constantinople. The sect was denounced in 428 by imperial edict, and its members gradually returned to the Church or became Monophysites (q.v.).

Apol'lo, son of Zeus (Jupiter) and Leto (Latona), who being persecuted by the jealousy of Hera (Juno), after tedious wanderings and nine days' labor, was delivered of him and his twin sister, Artemis (Diana), on the island of Delos. He was the most important of the Olympian deities after Zeus and appears in mythology as the god of poetry, music, and prophecy, the patron of physicians and shepherds, and the founder of cities. He aided Zeus in the war with the Titans and the giants, and destroyed the Cyclopes because they forged the thunder-bolts with which Zeus killed his son and favorite Asklepios (Æsculapius). All of the male sex dying suddenly without previous sickness were supposed to be smitten by the arrows of Apollo. In the oldest poems Apollo is exhibited as the god of song, being known in this function as Apollo Citharœdus. Two statues of Apollo Citharœdus are extant, one of them at the Glyptothek in Munich, the other at the Vatican, but their date is unknown. In the festivals of the gods and those of men in which they took part he plays and sings while the Muses dance around him. According to some traditions he invented the lyre, though this is generally ascribed to Hermes (Mercury). Marsyas, who ventured to contend with him on the flute, was conquered and flayed alive by the god. Apollo had another contest with Pan, in which the former played on the lyre, the latter on the pipe. Tmolus had already decided in favor of Apollo, when Midas, opposing the sentence, was decorated with a pair of ass's ears for his stupidity. That Apollo had the gift of prophecy appears from the Iliad, where he is said to have bestowed it upon Calchas and Cassandra; and in the Odyssey mention is made of an oracular response delivered by him in Delphi. The oracle at this place became very famous. He also revealed future events at Abæ in Phocis, Didyma near Miletus, Claros near Colophon in Ionia, Tenedos and Patara in Lycia. Apollo, in later times, came to be regarded as the god of physic, and was represented to be the father of Asklepios, the god of healing. He is reported to have taken charge for a long time of the herds of Admetus, according to some authorities voluntarily, according to others compelled by Zeus, on account of the murder of the Cyclopes, or the serpent Python. As a builder of cities, the founding of Cyzicum, Cyrene, and Naxos in Sicily is ascribed to him, while Homer relates that he built the walls of Troy together with Poseidon (Neptune), and afflicted the city afterward with a pestilence, because Laomedon defrauded him of his pay. According to the poets and sculptors, Apollo, with Ares (Mars), Hermes (Mercury), and Dionysos (Bacchus), belongs to the beardless gods, in whom the dawnings of early manhood appear. He is figured with a bow, a quiver and plectrum, a serpent, a shepherd's crook, a griffin and a swan, a tripod, a laurel, an olive-tree, etc. He was originally the sun-god; and though in Homer he appears distinct from Helios (the sun), yet his real nature is hinted at even here by the epithet Phœbus, the radiant or beaming. In later times the view was almost universal that Apollo and Helios were identical, and by this theory of his origin we can easily understand how he should be regarded as the god of pastures (Nomios) and of flocks (Karneios), the god that protects and causes the fruits of the field to grow, the god that gives fair winds to mariners (Embasios), etc. As he slew the Python, that is, the hostile powers of darkness, with his arrows (the sunbeams), so in later times he was looked on as the averter of evil, the bringer of help, and the punisher of overweening pride (as in the story of Niobe). From being the god of light and purity in a physical sense he gradually, as he became endowed more and more in the Greek mind with an ethical character, became the god of moral and spiritual light and purity, the source of all intellectual, social, and political progress. Thus he came to be considered as the god of song and prophecy, the god that purifies after the commission of crimes, that averts and heals bodily suffering and disease, the institutor and guardian of civil and political order, and the founder of cities. Though not one of the original gods of the Romans, his worship was introduced at Rome at an early period, probably in the time of the

Tarquins. Among the ancient statues of Apollo that are extant the most remarkable, and in the judgment of the learned and acute Winckelmann the best and most perfect that art has produced, is the one called the Apollo Belvedere, from the Belvedere Gallery in the Vatican at Rome; also called the Pythian Apollo, because it is supposed that the artist has represented the god in the moment of his victory over the serpent Python. This statue was found in the ruins of Antium in 1503. It is conjectured to be a careful copy of a Greek original, perhaps of the 4th century B.C., or possibly a century or more later.

Apol'lo Belvedere, bĕl'vā-dā'rā. See APOLLO.

Apollonius, Pergæus, from Perga in Pamphylia; lived about 250–200 B.C. He was educated in Alexandria under the successors of Euclid, and became one of the greatest mathematicians of antiquity, being commonly called the "Great Geometer." His most important work was a treatise on conic sections, in eight volumes, of which the first four, with the commentary of Eutocius, are extant in Greek, and all but the eighth volume in Arabic. We have also introductory *lemmata* to all the eight by Pappus, edited by Halley, 'Appolonius Pergæus Conic,' lib. VIII., c., Oxon. 1710. fol

Apollo'nius of Tyana, a Pythagorean philosopher, b. at Tyana, in Cappadocia, about whom many wonderful stories are told. He was born in the beginning of the Christian era, early adopted the Pythagorean doctrines, abstaining from animal food and living in the simplest manner, and according to the Pythagorean precept maintained a rigid silence for five years. He traveled in Asia, disseminating his doctrines and doing many wonderful things, and proceeding as far as India, where he became initiated into the doctrines of the Brahmans. When Domitian ascended the throne Apollonius was accused of having excited an insurrection in Egypt in favor of Nerva, but readily submitting to a trial he was acquitted. After this he went once more to Greece and passed over to Ephesus, where he opened a Pythagorean school, and died in 96, or, according to others, 110 A.D.

Apollyon, ă-pŏl'lĭ'ŏn, or ă-pŏl'yŭn, a rendering of the Hebrew Abaddon, meaning destruction. Apollyon is personified as the keeper of the bottomless pit.

Apolo'gia pro Vi'ta Su'a, the title given by Cardinal Newman to the account of his religious career, published in 1865. It was called forth by Charles Kingsley's accusation that "Truth, for its own sake, has never been a virtue with the Roman clergy. Father Newman informs us that it need not and on the whole ought not to be: that cunning is the weapon which heaven has given to the saints wherewith to withstand the brute male force of the wicked world, which marries and is given in marriage. Whether his notion be doctrinally correct or not, it is at least historically so." Newman deeming the time ripe for a full and searching justification of his position, and of the position of his brother clergy, published the 'Apologia' the next year. Its supreme value is its intimate revelation of a luminous spirituality, of a personality of lofty refinement and beauty.

Apologetics, the department of theological science which deals with the defense of the Christian faith. It differs from dogmatics which strives to reduce the doctrines of religion to a systematic form; and from polemics, which is the science of controversy, and while its subject matter comprises the differences found in different schools of believers, apologetics deals with attacks upon the faith which are made by unbelievers. Apologetics may be again distinguished from apologies. The former has to do with the fundamental principles of the religion and with the methods of defense which apply to all attacks, but an apology has to do with some special form of unbelief. The former is the science of which the latter is an application. Yet, apologetics as a science may be best understood through its historical applications and the distinction named is made more readily in theory than exhibited in detail.

Owing to the nature of Christian theology as historically formulated, apologies have fallen under two main divisions, popularly known as natural theology and the evidences of Christianity. The former is usually put before the latter. It discusses the nature of God and the proofs of His existence as revealed to us in nature. It may also investigate the nature of man, his moral sense, the freedom of his will, and his capacity for knowing God. Its chief reliance has been upon four arguments: the ontological, which starts from our idea of a perfect being and shows that it implies actual existence: the cosmological, which from the long line of causes and effects, each contingent, argues backward to a first great cause, which is itself uncaused; the teleological, which shows the marks of design in nature, and from them argues to a great designer; the moral, which starts with the moral sense in man and argues to a holy and righteous maker. Some writers add an æsthetic argument, from our sense of beauty and its gratification in the universe. Then these various arguments are combined and the perfect being is shown to be the first great cause, righteous, wise, and a person whom therefore we call God.

The evidences of Christianity assume the existence of such a God, and from this basis prove Christianity to be His peculiar revelation, constituting the absolute religion. This proof ordinarily is divided into two great divisions, external and internal. The external proofs are miracles and completed prophecy, which evince a power and wisdom which are Divine and guarantee the Divine authorship of the writings which they authenticate. The external proofs include also the historical evidence to the genuineness of the scripture writings. The internal evidences show the adaptation of the contents of the Bible to the needs of men, their agreement with the highest teachings of reason, and their elevating and purifying effect upon the mind and life. A further argument is based upon the experience of the Christian as testifying to the truth of the doctrines involved.

This argument in both divisions, natural theology and the evidences of Christianity, occupies the chief place in the text-books, but, evidently, it is a form of specific apology, and at best only in part illustrates essential apologetics. This appears from a wider survey for the argument as stated above, while it meets a special situation, neither represents the actual argumentation in the first ages of the Church

nor in our own day. Even in the New Testament some of the writings have an apologetic purpose. Christianity in its early form met two opponents, Judaism and heathenism. To the first, the apostolic writers attempted to prove its truth by showing it as foretold in the Old Testament, and as completing the earlier Scriptures. When Christianity encountered Greek thought the situation was wholly different, and the apologists formulated the contents of the Gospel in a manner which appealed to the common sense of all the serious thinkers and intelligent men of the age. That is, Christianity was presented as completing, or at least harmonizing with, the later Greek philosophy. In this it succeeded and then ensued a long period when apologetics was in abeyance. The intellectual life of the Church was engaged in formulating dogmas and in conflicts with heresy. Only long after the Reformation was the strife renewed with men who seriously denied the truth of Christianity.

In the end of the 17th century, and the beginning of the 18th century, the minds of English Churchmen were engaged by the Deistic controversy. This had to do with the evidences of Christianity. The Copernican astronomy, changing men's conceptions of the physical universe, the discovery of China, or better its rediscovery and its effect upon the imagination of thoughtful men, and the attacks of the British clergy upon the miracles of the Roman Catholic Church, brought on a crisis. The new astronomy suggested the thought that the God of so great a universe could not be identical with Jehovah, the God of a Semitic people; nor could men conceive of the earth, no longer central but a mere planet, as the scene of the drama of the incarnation and the redemption; the consideration of China with the thought of its relatively high civilization suggested that if China had got on so well without the special teaching of the gospel with the light of reason only, the special revelation must also be valueless to Englishmen; and the attacks of the clergy upon the Roman Catholic miracles as the frauds of priests led to the position that all miracles, including those of the Bible, may be put into the same category. It was further urged, that the description of Jehovah in the Bible and in the doctrines of the Church does not accord with the righteousness and wisdom and power of the God disclosed by nature. The conception of nature as a vast machine was taking possession of men's minds, and God was thought to be the maker and starter of the machine, and as having no further occasion to interfere with its running. He was not denied, therefore, but He was made infinitely remote, and there seemed no opportunity for miracle, redemption or prayer. The attack called forth a multitude of replies, the 'Analogy' of Bishop Butler being the most effective and distinguished. He argued that revealed and natural religion are not opposed, but that the second supplements the first, and that its peculiarities are what we should expect from a study of nature itself; and that further, the difficulties urged by the Deists against the God of the Bible lie with equal force against their own teaching of the God of nature. It was further argued, in particular, that the account of the gospel miracles is to be accepted, because the witnesses were competent, and moreover had everything to lose and nothing to gain by their invention, proving their sincerity by dying as martyrs. The Wesleyan revivals were perhaps more influential than the arguments of the apologists by supplying the powerful evidence of the effectual working of Christianity in the hearts and lives of men. From England the controversy was carried to France, and to Germany, with phases too varied for even the briefest review here.

In the 19th century, from the middle decades on, the apologetic warfare was renewed, with issues far more fundamental. Already Hume had stated positions which threatened the beliefs of Churchmen and of Deists alike, and under the influence of an extreme empiricism, reinforced by influences from German philosophy, men denied that God could be known at all. Hence apologetics again busied itself with the first division of topics, and discussed man's capacity for knowing the Infinite, and reviewed all the evidences for God's existence in the light of the modern science of knowledge. The progressive establishment of the scientific conception of the universe also revived the discussion as to miracles and forced a renewed examination of the whole subject. In addition, the historic credibility of the gospel narrative and the authenticity of the Biblical writings have been re-examined from many points of view, while the discovery of the ancient religions of the past and of the living religions of Asia have caused prolonged debate as to the uniqueness and the absoluteness of the Christian teachings. Hence, the apologist is engaged in a discussion which involves philosophy, science, history, comparative theology, and criticism.

In general, we may put apologists at present into three classes; those who hold substantially the old positions and seek in part by compromise and in part by adaptation to show that their essential truth may be maintained notwithstanding the progress in philosophy and science; those who abandon the old arguments, and overcome the conflict between science and philosophy on the one hand and theology on the other, by adopting wholly the modern views and reconstructing theology by their aid; and those who attempt to discriminate between religion and science and philosophy, and by penetrating more completely into its essence to find an independent basis for the religious life which shall abide however men's views may change in these other departments. Particular arguments in reply to special attacks are of less moment than a discussion of the meaning and essence of Christianity itself, and of the principles which underlie all defenses of its truth. That is, this age needs not so much an apology or defense of Christian truths as a thoroughgoing study of the science of apologetics itself.

Bibliography.— Butler, 'Analogy of Religion'; Paley, 'Evidences of Christianity'; Stephens, 'History of English Thought in the 18th Century'; Ebrard, 'Christian Apologetics'; Fisher, 'The Grounds of Theistic and Christian Belief'; Hettinger, 'Apology of Christianity'; Smythe, 'Through Science to Faith' (1902); Kaftan, 'The Truth of the Christian Religion' (1894); Knox, 'The Direct and Fundamental Proof of the Christian Religion' (1903).

GEORGE WM. KNOX, D.D.,
Professor of Philosophy and History of Religion, Union Theological Seminary.

Ap'ologue, a story or relation of fictitious events intended to convey some useful truth. It differs from a parable in that the latter is drawn from events that pass among mankind, whereas the apologue may be founded on supposed actions of brutes or inanimate things. Æsop's fables furnish excellent examples of apologues.

Apol'ogy, a term at one time applied to a defense of one who is accused, or of certain doctrines called in question, but at present commonly applied to an acknowledgment of error. The apologies of Socrates attributed to Plato and Xenophon are works of the first-named character. Later rhetoricans wrote upon the use of apologies and caused them to be composed by their scholars. Of this sort are the Apologies of Libanius. Thus the name passed over to Christian authors, who gave the name of apologies to the writings which were designed to defend Christianity against the attacks and accusations of its enemies, particularly the pagan philosophers, and to justify its professors before the emperors. Of this sort were those by Justin Martyr, Athenagoras, Tertullian, Tatian, and others. There are also apologies for the doctrines of particular sects; for example, Robert Barclay's 'Apology for the People in Scorn called Quakers.'

Apol'ogy for the Life of Colley Cibber, An, an autobiography published in 1740, when the author, poet-laureate, actor, and man-about-town was in his 70th year. In the annals of the stage this curious volume holds an important place as throwing light upon dramatic conditions in London after the Restoration, when the theatre began to assume its modern aspect.

Ap'omor'phine. See MORPHINE.

Aponeurosis. See TENDON.

Apoph'yllite, ă-pŏf'ĭ-līt (from the Greek words *apo,* «off,» and *phyllon,* «leaf,» in allusion to the tendency of the mineral to separate into thin leaves before the blowpipe), a native hydrated silicate of calcium and potassium, having the general formula $K_2O.8CaO.16SiO_2.16H_2O$, but with some portion of the oxygen replaced by fluorine. It crystallizes in the tetragonal system, and also occurs massive. Its crystals are usually white or gray, with a pronounced pearly lustre on the basal plane, and a vitreous lustre elsewhere. Apophyllite cleaves easily into thin folia parallel to the basal plane. Its hardness is from 4.5 to 5, and its specific gravity about 2.3. It occurs in many parts of the world. Beautiful crystals, 3 or 4 inches across, are found in India, and others nearly as large have been found at Bergen Hill and Paterson, N. J.

Apoplexy. See BRAIN DISEASE.

Aposiopesis, ăp'ō-sĭ-ō-pē'sĭs, a rhetorical term denoting a sudden break or stop in speaking or writing, usually for mere effect or a pretence of unwillingness to say anything on a subject; as, «his character is such —— but it is better I should not speak of that.»

Apos'tasy (Greek, *apostasis,* a standing away from), a term signifying a renunciation of opinions or practices and the adoption of contrary ones, and usually applied to renunciation of religious opinions. It is always an expression of reproach. What one party calls apostasy is termed by the other conversion. History mentions three eminent apostates — Julian the Apostate, who had never been a Christian except nominally and by compulsion; Henry IV., king of France, who thought that «Paris vaut bien une messe,» and that of course all France was worth the whole Catholic faith; and William of Nassau, the stadtholder, who separated himself from the Roman Catholic Church and became a Protestant. The statute 9 & 10 of William III. cap. xxxii., provides that if any person educated in or having made profession of the Christian religion shall deny it to be true, he shall be rendered incapable of holding any office for the first offense, and for the second shall be made incapable of bringing any action, of being guardian, executor, legatee, or purchaser of lands, and shall suffer three years' imprisonment without bail. This act is commonly called the «blasphemy act.»

A Posteriori. See A PRIORI.

Apos'tle (literally one sent out, from the Greek *apostellein,* to send out) and in the Christian Church the title given to the 12 men whom Jesus selected to attend him during his ministry, witness his miracles, learn his doctrines, and thus be able to promulgate his religion. Their names were Simon Peter and Andrew his brother; James the greater, and John his brother, who were sons of Zebedee; Philip of Bethsaida; Bartholomew; Thomas; Matthew; James, the son of Alpheus, commonly called James the less; Lebbeus, his brother, who was surnamed Thaddeus, and was called Judas or Jude; Simon the Canaanite; and Judas Iscariot. Of this number Simon Peter, John, James the greater, and Andrew were fishermen; and Matthew a publican or tax-gatherer. When the apostles were reduced to 11 by the suicide of Judas, who had betrayed Christ, Matthias was chosen by lot on the proposition of St. Peter. Soon after, their number became 13 by the miraculous vocation of Saul, who, under the name of Paul, became one of the most zealous propagators of the Christian faith. The Bible gives the name of apostle to Barnabas also, who accompanied Paul on his missions (Acts xiv. 14), and Paul seems to give it to Andronicus and Junia, his relations and companions in prison. Generally, however, the name is used in the narrower sense to designate those whom Christ selected himself while on earth, and Paul, whom he afterward called. In a wider sense those preachers who first taught Christianity in heathen countries are frequently termed apostles: for example, St. Denis, the apostle of the Gauls; St. Boniface, the apostle of Germany; St. Augustine, the apostle of England; the Jesuit Francis Xavier, the apostle of the Indies; Adalbert of Prague, apostle of Prussia Proper. Tradition reports that several of the early apostles were married. The wife of St. Peter is said to have accompanied him on his journeys, and died a martyr. The tradition further states that St. Peter had a daughter Petronilla, who was also a martyr; this at least say St. Augustine, St. Epiphanius, and St. Clement of Alexandria. St. Philip also is said to have been married and to have had several daughters, among whom was St. Hermione. Hegesippus speaks of two martyrs, grandsons of St. Jude.

His wife was called Mary. St. Bartholomew is also said to have been married. Their history is largely a matter of tradition, save as it is recorded in the Acts of the Apostles.

Apostle of the Ardennes. See HUBERT, ST.

Apostle of the English. See AUGUSTINE, ST.

Apostle of Free Trade. See COBDEN, R.

Apostle of Germany. See BONIFACE, ST.

Apostle of Infidelity. See VOLTAIRE.

Apostle of Ireland. See SAINT PATRICK.

Apostle of Temperance. See MATHEW, T.

Apos'tle Spoons, a name applied to sets of spoons with handles formed of images of the Twelve Apostles and the Virgin.

Apostles' Creed. See CREED.

Apos'tles' Is'lands, or **The Twelve Apostles,** the name given to a group of 27 islands in Lake Superior, belonging to Wisconsin. The principal islands of the group are Ile au Chêne, Stockton, Bear, Madeline, and Outer. They have an area of 200 square miles. Brown sandstone is exported, and the islands are covered with a rich growth of timber. The cliffs have been worn into strange forms by the action of the waves. La Pointe, on Madeline Island, formerly the county-seat of Ashland County, Wisconsin, was settled by the French, who established Jesuit missions on the islands as early as 1680.

Apostle to the French. See DENIS, ST.

Apostle to the Indians. See ELIOT, JOHN.

Ap'ostol'ic Brethren, Apostolici, or **Apostolics,** the name given to certain sects who professed to imitate the manners and practice of the apostles. The last and most important of these was founded about 1260 by Gerhard Segarelli of Parma. They went barefooted, clothed in white, with long beard, disheveled hair, and bare heads, accompanied by women called spiritual sisters, begging, preaching, and singing, throughout Italy, Switzerland, and France; announced the coming of the kingdom of heaven and of purer times; denounced the papacy and its corrupt and worldly Church; and inculcated the complete renunciation of all worldly ties, of property, settled abode, marriage, etc. This society was formally abolished (1286) by Honorius IV. Segarelli was burned as a heretic in 1300. Another leader now appeared, Dolcino, a learned man of Milan. In self-defense they stationed themselves in fortified places whence they might resist attacks. After having devastated a large tract of country belonging to Milan they were subdued (1307) by the troops of Bishop Raynerius in their fortress Zebello, in Vercelli, and almost all destroyed. Dolcino was burned at Vercelli, 1 June 1307. The survivors afterward appeared in Lombardy and in the south of France as late as 1368.

Apostolic Church, the Church in the time of the apostles, constituted according to their design. The name is also given to the four churches of Rome, Alexandria, Antioch, and Jerusalem, and is claimed by the Roman Catholic Church and occasionally by the Episcopalians.

Apostolic Constitutions and Canons, a collection of regulations attributed to the apostles, but generally supposed to be spurious. They appeared in the 4th century, are divided into eight books, and consist of rules and precepts relating to the duty of Christians, and particularly to the ceremonies and discipline of the Church.

Apostolic Delegate, a permanent representative of the Pope in a foreign country. The term is sometimes confounded with the word ablegate, the latter meaning a temporary representative of the Pope for some special function.

Apostolic Fathers, the Christian writers who, during any part of their lives, were contemporary with the apostles. There are five: Clement, Barnabas, Hermas, Ignatius, Polycarp. Their writings are available in a recent collection made with great care by the able Biblical scholar, Bishop Lightfoot.

Apostolic Fathers, The: Revised Texts, with English Translations. By J. B. Lightfoot. A collection of about 12 of the earliest Christian writings, directly following those of the Apostles, made with great care and learning by the ablest of recent English Biblical scholars. The writings gathered into the volume represent those teachers of Christian doctrine who stand in the history nearest to the New Testament writers, and the account of them given by Dr. Lightfoot is not only the best for students, but is of great interest to the general reader.

Apostolic Majesty, a title granted by the Pope to the kings of Hungary, first conferred on St. Stephen, the founder of the royal line of Hungary, on account of what he accomplished in the spread of Christianity.

Apostolic Party, a name given to a body of Spanish fanatics who early in the 19th century clamored for the restoration of the Inquisition. About 1830 they became merged in the Carlist party.

Apostolic See, official title of the Pope, the Bishop of Rome, who, according to the doctrine of the Catholic Church, is the successor of Saint Peter.

Apostleship of Prayer, a pious association founded in France in 1844 by Rev. Francis Gautrelet for the purpose of advancing its members in the spiritual life and particularly of honoring the Sacred Heart of Jesus. There are three degrees of membership, composed of those who promise to make the morning offering of their thoughts, words, actions, and sufferings to God in union with the intention of Christ; those who recite once each day the Lord's Prayer and the Hail Mary ten times; and those who receive Holy Communion monthly as an act of reparation to the Sacred Heart of Jesus. The membership throughout the world is supposed to be about 30,000,000, and there are about 5,000,000 in the United States. The central office is at Saint Francis Xavier Church, New York.

Apostolic Succession. The doctrine of the direct and hierarchical succession from Christ's apostles. Its defenders maintain that the Christian ministry is a succession, that valid ordination is transmitted to the clergy only by accredited bishops who have received the power of ordination in direct line of succession from the apostles. The points of controversy are: (1) as to when and how the exclusive authority of ordination was given by Christ and the apostles; (2) by what act, if any, the transmission of this authority is to be made valid, (3) along what

lines has this supernatural commission come, and (4) whether or not this supernatural grace and spiritual authority are restricted to definite official lines of transmission. In later years differences have arisen among the Anglican scholars regarding these various points. Independents and Dissenters in England, of course, argue in favor of the theory that the Church itself as a body may constitute a legitimate ministry, with full powers of ordination, etc. This in general is the attitude of non-prelatical bodies. In defense of the doctrine see Gore, 'The Church and the Ministry' (1892); in opposition see John Brown, 'Apostolic Succession' (1898).

Edwin Knox Mitchell,
Hartford Theological Seminary.

Apos'trophe, a term in rhetoric indicating a figure of speech by which, according to Quintilian, a speaker turns from the rest of his audience to one person, and addresses him singly. Now, however, the signification is wider, including cases in which an impassioned orator addresses the absent, the dead, or even things inanimate.

The name is also employed in grammar to denote the substitution of a mark like this (') for one or more letters omitted from a word, as *tho'* for *though, 'twas* for *it was, king's* for *kinges.* It is also applied to the mark indicating such substitution, especially in the case of the possessive. The old possessive singular was *es,* and the apostrophe stands for the omitted *e.*

Apotheo'sis, a Greek term indicating the ceremony by which a man was raised to the rank of the gods. The custom of placing mortals, who had rendered their countrymen important services, among the gods was very ancient among the Greeks, who generally followed in so doing the advice of an oracle. On their coins most of the founders of cities and colonies are immortalized as gods; and in subsequent times living princes assumed this title. The Romans for several centuries deified none but Romulus, and first initiated the Greeks in the fashion of frequent apotheosis after the time of Cæsar.

Appalachian America, a term first used by the present writer in 1893, now generally accepted to designate the mountain region of the southern United States. This territory has a certain sociological unity, based on physical conditions, which was long obscured by the fact that it was parceled out among several different States.

Physiographically it is a mountainous territory without arms of the sea, inland lakes or other natural waterways. And furthermore it is a territory which forbids canals, and has not yet been opened up by railroads or even turnpikes. Its universal characteristics are difficulty of communication, isolation, and remoteness. These conditions were less severe, and were largely overcome by greater commercial and intellectual activity in the portions of the Appalachian system which lay in the northern free States. Accordingly as a sociological grand division Appalachian America begins with the southern boundary of Pennsylvania and the Ohio River, and embraces the mountainous portions of the Virginias and Carolinas, Kentucky and Tennessee, Georgia and Alabama. In this vast area, which is all a land of saddles and bad roads, there are, of course, great varieties of elevation and climate, from the "dissected plateaus" of Kentucky to "the land of the sky" in North Carolina. Descriptions of the geological formations, mineral, forest, and other resources, and physiographic conditions, will appear under the several States. But the one great fact about the whole territory is that it condemns its inhabitants to the ills of isolation.

Historically, Appalachian America received its first sparse settlements about the time of the Revolutionary War. A great tide of migration passed through it and around it to the West, and the valley land was occupied by hardy settlers. It was these who fought the battle of King's Mountain, and in the war of 1812 riflemen from the mountains gave material assistance in defeating the British at New Orleans. When the slave power developed in the South subsequent to the Revolution, Appalachian America, retaining its revolutionary spirit of liberty, came to be looked upon with hostility by its Southern neighbors. Slavery was never common in the mountains, and the scorn of the slaveholders for those who did not hold slaves was heartily returned by the mountaineers. Thus social barriers were added to the barriers of nature and the mountain people still further isolated from the world. In the Civil War, however, they emerged from their obscurity and surprised both the North and the South by their vigorous and effective stand for "union and liberty." They held Kentucky in the union, made West Virginia "secede from secession," well-nigh divided Tennessee, and furnished recruits to the loyal armies even from Alabama and South Carolina. Many of these recruits were not enrolled as coming from these States, but the regular regiments enlisted from slave States, nearly all from the mountains, aggregated about 200,000 men. The sufferings of the loyal people throughout the mountains, and especially in East Tennessee, and the eloquence of "Parson Brownlow," for the time fixed the attention of the nation. Naturally the mountaineers have since the War followed the fortunes of the Republican party.

Sociologically Appalachian America reveals most interesting survivals of the spirit, arts and conditions of colonial times. Within its area are many valleys and villages which differ from other parts of the United States only in superficial matters like the greater number of saddle horses and the more free hospitality. But there is an immense population (commonly estimated at 2,000,000) which has been little affected by modern ideas. The stock is mainly British, representing rural England and the Scotch-Irish, though with traces of the Huguenot and the German. A large number of Washington's soldiers settled in the valley land of Appalachian America, and there is no evidence that the pioneers of the mountain region were in any way inferior to the first settlers in the more favored "blue grass sections." The early settlers had the education of their time, which lessened in succeeding generations. The conditions of life grew harder when the valley land and game were exhausted, and the public school did not come in until the "reconstruction period." As a result, a great part of all the native born illiterates in the United States — many of them people of good character and good abilities — are in this region. In some counties the

illiterate white voters exceed a third of the whole number. It is among these people that we find a survival of pioneer conditions — the woodcraft, the log cabin, the open fireplace — with a noble stone chimney in Kentucky, degenerating into a stick and mud chimney farther south. The arts of spinning, dyeing, and weaving are still found, together with a wealth of Saxon speech, and even old British ballads which have come down by oral tradition. Survivals in language consist of ancient pronunciations and constructions, and the persistence of words and meanings elsewhere obsolete; as "pack" for carry, "gorm" meaning to muss, etc. A kind of minstrelsy still exists among the ruder classes, so that we may find drinking songs and folk-lore still in the making. Preachers are few and poorly paid, and religion is of a mediæval and fatalistic type. The feuds and homicides which attract so much attention belong with these other survivals. Weapons are carried to some extent in all parts of the South, because men retain the Elizabethan idea that while the government protects the land from foreign foes, each man is to protect his private honor and interests with his own right arm. In the mountains this view is more plausible because the law is not always carried out with the certainty and majesty which could inspire either confidence or dread. Considering these adverse conditions of life, the general good order and morality of the mountains is very creditable. A woman or a stranger who behaves properly is always safe. The chief disorders arise from corrupt political leaders and the whiskey bottle, and the mountain people have taken the first great step of progress in very generally enacting local option laws which prohibit the sale of intoxicants. Yet the "moonshine still" — the secret manufacture of spirits on which no tax is paid — survives in many places, and makes Christmas or election time a terror to the mothers of mountain boys.

A most striking characteristic is the absence of any foreign element in the population. The 35 mountain counties of Kentucky, for example, contain 478,205 people, with only 2,120 who are of foreign birth, and these massed in a few counties where mines or lumber interests have been recently established. There are 15 counties each containing less than ten persons of foreign birth. The massing of so great a population of purely American birth and breeding is very significant. And these people who owned land but did not own slaves (never to be confused with the "poor whites") constitute the true yeomanry of the South, its best nucleus for a true middle class. Large families are the rule, and the standard of physical development is high. With this large birth-rate the mountain region is approaching the limit of population and must either improve the means of subsistence, or emigrate. Both movements have begun. In time the mineral wealth will bring railroads to some extent, and if proper educational guidance is furnished Appalachian America will become what Scotland is in Great Britain, a storehouse of national vigor and patriotism.

Printed information regarding Appalachian America is fragmentary and partial. Chas. Dudley Warner reported a charming tour 'On Horseback Through Virginia' and important notices occur in Fisk's 'Old Virginia and her Neighbors,' Roosevelt's 'Winning of the West,' and Draper's 'King's Mountain and its Heroes.' The spirit of war times is reproduced in Barton's 'Hero in Homespun,' and the general characteristics of mountain life appear in the tales of John Fox, Jr., and Miss Murfree ("Charles Egbert Craddock"). See also articles in 'New England Magazine' (March '97), 'Atlantic Monthly' (March '99), 'Review of Reviews' (March 1900), and files of the 'Berea Quarterly.'

W. G. Frost,
President Berea College.

Appalachian Mountain Club, the name of an organization interested in the exploration and study of the mountain ranges of eastern North America, and the preservation of their woodlands, waters, and historic sites for the use of the public. The club publishes a journal, called 'Appalachia,' now in its 10th volume (1903).

Appalachian Mountains, the great mountain system of the eastern United States extending from southeastern New York to northern Alabama. It includes a number of ranges and mountain groups of which the most important are the Alleghanies, the Blue Ridge, the Cumberland Mountains, and the Black mountains. The Catskills form really the northern termination, although the system is commonly extended so as to include the Green Mountains, the White Mountains, and the line of elevations extending northward of the Gulf of St. Lawrence. The extreme length of the system is about 1,300 miles, and its greatest width over 100 miles. The most remarkable feature of the general formation of the Appalachians is the regular arrangement of its ridges and valleys, these being, in general, parallel to the Atlantic coast line. This arrangement is particularly noticeable in the central part of the system, through Pennsylvania and Virginia. In general the ridges lie along two parallel lines from 50 to 100 miles apart, thus enclosing a longitudinal valley whose sides rise rather abruptly over culminating points of the mountains. This great central valley extends from New York to the southern end of the system, including the Cumberland valley in Pennsylvania and the great valley of Virginia and of Tennessee. This region is very fertile throughout its whole length, and is especially well cultivated in Lancaster, Berks, and Lehigh counties, Pennsylvania. The Appalachians show no remarkable elevations, and the height of the summits appears less than it really is, because the mountains rise from a plateau varying from 500 feet in Pennsylvania to 1,500 and 2,000 feet in Virginia and Tennessee. The lowest peaks are found in Pennsylvania, none rising much above 2,000 feet. The culminating point of the whole system is Mount Mitchell, in the Black Mountains (6,711 feet): others of the high peaks are also found in the Black Mountain range, Balsam Cone 6,671 feet, Black Brother 6,619, and Mount Hallback; the Smoky Mountains, too, include some high peaks, Clingmann Dome 6,619, Guyot 6,636, Mount Alexander 6,447, Mount Seconte 6,612, and Mount Curtis 6,568. The culminating point of the northern part of the system is Mount Washington, New Hampshire (6,233 feet). The peaks are generally of rounded outline and lack the bold picturesqueness that characterizes the

Rocky Mountains and other ranges in the western United States. Their low altitude and smooth contour are the result of the long-continued erosion which has removed great thicknesses of strata since the first uplift.

Geology.— The Appalachians show all geological formations from the metamorphic group to the so-called coal-measures, the latter including sandstones, shales, limestones, and coal. The strata of the western slope with their regular horizontal arrangement show a great contrast to the disturbed stratification of the eastern slope. There the rock formations are con fused and pressed into folds and wrinkles with an inclination generally southeast. The strata of the system are all of marine or terrestrial origin, the latest being those of the coal formation. After the formation of these strata the mountains were elevated to their present position by a force that proceeded from the southeast, working probably by many successive impulses; and the receding waters hollowed the gaps through the ridges so characteristic of the Appalachian topography, and gave the mountains their present conformation. The chief minerals of the Appalachians are iron and coal. Iron ores, magnetite, hematite, and limonite, are very abundant; the magnetic iron is found especially in what is called the Champlain Iron District. The hematite and limonite ores are found all along the great Appalachian valley and are of great commercial importance; while the earthy carbonite of iron found in many parts has been largely manufactured. Coal is perhaps the most important product; the coal deposits of the Appalachians include the whole anthracite field of Pennsylvania and New York with an area of 400 to 500 square miles, and the bituminous fields of Pennsylvania and other States, with an area of 56,000 square miles. Gold, silver, copper, and lead are found in comparatively small quantities and are of little importance commercially, but the deposits of marble, limestone, fire-clay, gypsum, and salt are abundant and valuable.

Drainage.— The Appalachians form the watershed between the Atlantic Ocean and the Mississippi River systems; this does not lie in one continuous line, but shifts its position from one line of ridges to another, so that many of the rivers cut their way through the mountains from west to east, or east to west; the Delaware and Susquehanna, for example, with their branches. These two rivers, with the Potomac and James, drain the most of the eastern slope; the Ohio, with its tributaries, is the chief means of drainage on the western slope.

Flora and Fauna.— The mountain slopes are heavily wooded throughout the whole system. The white pine is found in all portions; the sugar maple, the white birch, ash, and beech grow on the northern mountains; the oak, cherry, white poplar, white and yellow pine farther south. On the poorer lands the evergreens flourish, such as spruce, hemlock, evergreen, and balsam-fir, which, on account of their dark foliage covering the summits of the Black Mountains, have given this range its name. There are large quantities of flowering shrubs, particularly the rhododendrons, azaleas, and laurel often growing in almost impenetrable thickets, and many varieties of smaller plants and flowers. Panthers and wolves have practically disappeared from the mountains, but bears, deer, and wild-cats are quite common. Small game birds are plentiful, and wild turkeys also on the southern ranges. Rattlesnakes and copperheads are found in all parts of the Appalachians, but not in great numbers.

Bibliography.— Guyot, 'The Appalachian Mountain System' ('American Journal of Science,' 2d Series, Vol. XXXI); Hayes, 'The Mechanics of Appalachian Mountain Structure'; 'Physiography of the Chattanooga District' (13th and 10th Annual Report of the United States Geological Survey); 'The Southern Appalachians'; H. D. and W. B. Rogers, 'Physical Structure of the Appalachian Chain' ('American Journal of Science,' 1st Series, Vol. XLIV); Willis, 'The Northern Appalachians'; 'Paleozoic Appalachia.'

Apparent, a term employed by mathematicians and astronomers to denote things as they appear to the eye in distinction from what they really are. Thus they speak of apparent motion, magnitude, distance, height, time, etc. So important is this difference between reality and appearance, particularly in regard to the heavenly bodies, that we find all early astronomers, who were ignorant of this fact, running continually into error; and a great advancement in science was required before mankind was able to establish systems opposed to appearances. Every one knows that a body may appear to move while it is, in fact, at rest, and the motion is in the spectator, or the place on which he stands, as is the case with the sun in relation to the inhabitants of this earth. The apparent altitude of a heavenly body is what appears to be its angle of elevation above a horizon which may itself be apparent — that is, the seeming junction of sea and sky; or "sensible" — that is, a plane passing through the point of observation at right angles to the plumb-line; or true — that is, a plane parallel to the "sensible" horizon and passing through the centre of the earth. When the altitude of a heavenly body is measured corrections are made for refraction, parallax, and, if the measurement is from a visible sea horizon, for the height of the observer above the water.

The phrase heir apparent signifies one whose right of inheritance is indefeasible provided he survive his ancestor; as the eldest son or his issue, who must, by the course of the common law, be heirs to the father. Heirs presumptive are those who, if the ancestor should die immediately, would in the existing state of things be his heirs.

Ap'pari'tion, the name given to an illusion involuntarily generated, by means of which forms not present to the actual sense are depictured with intensity sufficient to create a temporary belief in their reality. It is now generally held to be the result of the reaction of an excited imagination, renovating past feeling or impressions, with an energy proportioned to the degree of excitement. But although the illusion thus generated is necessarily co-existent with the state of excitement in which it has its origin, or, in other words, ceases to be active when the phenomena vanish, it does not therefore follow that the mind, when it regains its ordinary condition, becomes immediately sensible of the hallucination under which it has for a time been laboring, or capable of

distinguishing between perceptions of sense and phantasms of imagination. On the contrary, observation proves what theory equally sanctions, that the conviction of reality generally outlasts the impressions which originally produced it; and that, so far from any suspicion of illusion being entertained, or any power of discriminating the actual from the imaginary being evinced, this conviction takes entire possession of the mind, in many instances maintaining its hold with a firmness which all the force of argument and reason is insufficient to overcome. Hence the tenacity, and, we may add, the universality of the belief in apparitions; and hence also the prodigious diversity of forms under which these spectral illusions are presented in the popular legends and superstitions — a diversity, in fact, which seems commensurate with the incredible variety of influences, whether morbific or other, by which the imagination may be excited, and past feelings or impressions vividly renovated in consequence of its reaction on the organs of sense. Sir D. Brewster has remarked as a physical fact that «when the eye is not exposed to the impressions of external objects, or when it is insensible to these objects, in consequence of being engrossed with its own operations, any object of mental contemplation, which has either been called up by the memory or created by the imagination, will be seen as distinctly as if it had been formed from the vision of a real object. In examining these mental impressions,» he adds, «I have found that they follow the motions of the eyeball exactly like the spectral impressions of luminous objects, and that they resemble them also in their apparent immobility when the eyeball is displaced by an external force. If this result shall be found generally true by others it will follow that the objects of mental contemplation may be seen as distinctly as external objects, and will occupy the same local position in the axis of vision as if they had been formed by the agency of light.» This goes to the very root of the theory of apparitions, all the phenomena of which seem to depend upon the relative intensities of the two classes of impressions, and upon the manner of their accidental combination. In perfect health the mind not only possesses a control over its powers, but the impressions of external objects alone occupy its attention, and the play of imagination is consequently checked, except in sleep, when its operations are relatively more feeble. But in the unhealthy state of the mind, when its attention is partly withdrawn from the contemplation of external objects, the impressions of its own creation, or rather reproduction, will either overpower or combine themselves with the impressions of external objects, and thus generate illusions which in the one case appear alone, while in the other they are seen projected among those external objects to which the eyeball is directed, in the manner explained by Sir D. Brewster. It may be added that the reasoning applied to the impressions derived from the sense of sight is equally applicable to those received through the medium of any other sense,— as the ear, for instance, an organ which ministers abundantly to the production of spectral illusions. This theory explains only those apparitions known to be subjective illusions, but it does not account for those objective apparitions, of which there are many and well authenticated accounts. Modern science has explained some of the objective apparations.

Appeal', a legal term signifying the removal of a cause from an inferior tribunal to a superior, in order that the latter may revise, and, if needful, reverse or amend, the decision of the former.

In the United States the distinction between an appeal, which originated in the civil law, and a writ of error, which is of common law origin, is that the former carries the whole case for review by the higher court, including both the facts and the law; while the latter removes only questions of law. An act of Congress of 1875 provides that the judgments and decrees of the circuit courts of the United States shall not be re-examined in the supreme court unless the matter in dispute shall exceed the sum or value of $5,000, exclusive of costs. No judgment, decree, or order of a circuit or district court, in any civil action at law or in equity, shall be reviewed in the supreme court on writ of error or appeal unless the writ of error is brought or the appeal is taken within two years after the entry of such judgment, decree, or order; save in the case of infants, insane persons, and imprisoned persons, when the period is two years exclusive of this term of disability. An appeal from a district court to a circuit court of the United States must be taken within one year. An appeal from the district court in admiralty to the circuit court must be made immediately after the decree, in open court, before the adjournment *sine die;* and should be taken to the next succeeding circuit court. An appeal may be taken from the State courts to the supreme court of the United States, in cases involving the validity of a treaty or statute of, or authorized under, the United States; on the ground of repugnance to the Constitution, etc.

The effect of an appeal is generally to annul the judgment of the lower court so far that no action can be taken upon it until after the final decision of the cause. In many States, before the judgment of an inferior court will be reversed on the ground of error, the appellant, as the party taking the appeal is called, must show to the court that substantial injustice has been done him. In other States courts have held that when an error is shown to have been committed it will be presumed to have been prejudicial to the complaining party, and the judgment will be reversed unless the respondent shows that the error was harmless. Appellate courts, however, will not reverse the judgments of trial courts for technical or other errors where it appears from the record itself that the errors complained of were not prejudicial to the appellant.

In legislation an appeal is the act by which a member of a legislative body who questions the correctness of a decision of the presiding officer, or «chair,» procures a vote of the body upon the decision. In the House of Representatives of the United States the question on an appeal is put to the House in this form: «Shall the decision of the chair stand as the judgment of the whole House?» If the appeal relate to an alleged breach of decorum, or violation of the rules of order, the question is taken without debate. If it relate to the admissibility or

relevancy of a proposition, debate is permitted, except when a motion for the previous question is pending.

Appear'ance, a legal term implying the coming into court as a party to a suit or action, whether as plaintiff or defendant. On the part of the plaintiff no formality is required. The appearance of the defendant may be effected by making certain formal entries in the proper office of the court, expressing his appearance, or in case of arrest is effected by giving bail, or by putting in an answer or a demurrer.

Appen'dici'tis, the name applied to an infectious disease of the vermiform appendix, a small organ occupying the lower right side of the abdominal cavity. The first authentic record of the distinct localization of a lesion in the appendix was by Saracenus in a letter dated 28 Aug. 1642. A number of observers described the disease in later years, but it is to the honor and credit of American medicine that Reginald Fitz of Boston wrote his epoch-making memoir in 1886, 'On Perforative Inflammation of the Vermiform Appendix.' Two years later Fitz advanced the sound theory that the diseases variously described as typhlitis, peri-typhlitis, para-typhlitis, appendicular peritonitis, and peri-typhlitic abscess were all varieties of one and the same affection: namely, appendicitis. Rapid strides have been made during the last decade in the study of the disease, and mainly through the exertions of American surgeons the treatment of appendicitis has been placed upon a sound and rational basis. In the embryologic development of the human intestinal tract there is at first a straight tube, divided into the foregut, midgut, and hindgut, each of which gives rise to different structures. From the midgut a diverticulum or pouch appears which marks the dividing line between the large and small intestine. This pouch becomes larger and is called the cecum, but its terminal portion does not keep pace with the growth of the base and remains as a small projection depending from the cecum. This is the appendix vermiformis; it has no function and merely serves as a constant source of menace from its liability to disease.

During early intra-uterine life the appendix lies near the umbilicus (navel), but about the sixth month descends into the right iliac fossa. If two lines are drawn at right angles to each other, intersecting at the umbilicus, the abdomen will be divided into four quadrants. The lower right quadrant will include the right iliac fossa, and in the majority of cases the appendix. The base of this organ will usually be found at a point two inches from the umbilicus on a line drawn from the latter to the anterior superior spine of the iliac bone and known as McBurney's point.

The appendix is held in place by a fold of peritoneum called the meso-appendix, through which a single artery runs to supply the needed nutrition. The meso-appendix is derived from the lower layer of the mesentery, the fold of peritoneum which suspends the small intestine. In women there is usually, in addition, another blood-vessel which comes up to the appendix from the ovary. The end of the appendix is free and may point in any direction. This fact explains the great diversity of the symptoms often noted in appendicitis.

Bearing in mind, then, that the appendix is without a function, hangs in a dependent position from a portion of bowel always containing irritating material, and has a very poor blood supply, it can readily be understood why this organ is so often attacked by disease. It hangs in a cavity lined by peritoneum, a delicate membrane covering the inner surface of the abdomen and the exterior of the intestines, which easily absorbs poisons, transmitting them to the whole body. Inflammation of this membrane is known as peritonitis, a very fatal disease, and one often caused by appendicitis. Many deaths supposed to be due to peritonitis pure and simple are really caused by appendicitis. The intestines at all times are loaded with germs which under favorable conditions may be converted into deadly little organisms. These microbes attack the inner coat of the appendix, destroy it with the formation of pus, and may ulcerate through all the walls of the appendix causing an abscess with peritonitis. But for such a sequence of events to occur certain other factors are necessary. The old idea that foreign bodies, such as grape-seeds, are the cause of the disease, is now known not to be true. While foreign bodies are frequently found in the appendix, in rare instances only they are seeds, etc., but are almost always found to be hard masses of fecal material which has entered the appendix while soft, become dry and hard, forming a fecal concretion (*fecal calculus*). By exerting pressure on the wall of the appendix these hard bodies may aid in the production of the disease. In rare instances pins have found their way into the lumen of the appendix and induced appendicitis. It is interesting in this connection to note that worms are frequently discovered in the appendix. The *Oxyuris vermicularis*, or seatworm, has been found in large numbers, completely filling the appendix, and the *Ascaris lumbricoides*, or roundworm, has sometimes occupied this organ. In studying the etiology of appendicitis we find the young are more frequently attacked than the old, the disease occurring less commonly in those over 50 years of age. It is fortunate that such is the case, because older people do not stand operations as well as those in early adult life. Their resistance to shock is less, and the liability to kidney breakdown and to pneumonia would result fatally in many instances. The greater susceptibility of young adults to appendicitis is due to the numerous disturbances of their gastro-intestinal tracts from dietary indiscretions, and, secondly, to the proneness to inflammation of the adenoid (glandular) tissues throughout the body during adolescence. Analogy is found in the predominance of lesions of the tonsils and of the glands in the neck and mesentery during the period of development. In children appendicitis is characterized by the intensity of the lesion and by the remarkable recuperative power which children have. About two thirds of all cases of appendicitis occur in males. The reason for such a disparity is to be found in several facts. Females are less exposed to inclemencies of the weather and other deleterious influences, they undergo less muscular exertion, and their appendixes in the majority of instances have a better blood supply. Of diseases that predispose to appendicitis may be mentioned constipation, gastro-enteritis,

dysentery, typhoid fever, influenza, etc. Constipation exerts an influence by causing sluggishness of the bowels, resulting in poor drainage of the appendix. Noxious materials may be retained and favor an increase in the virulence of bacteria, especially the *Bacillus coli-communis*. Gastro-enteritis, or inflammation of the stomach and intestines, is a very important factor in appendicitis. In this disease the cecum may become inflamed and by extension involve the appendix. In many instances such is the mildness of the alterations in the walls of the appendix that they do not engender any clinical manifestations. At times, however, the lining membrane of the appendix is directly attacked, and acute appendicitis may supervene. Under other circumstances catarrhal changes of mild degree persist and lead to chronic appendicitis. Dysentery and typhoid fever are more remote causes of appendicitis. They cause catarrhal alterations, swelling, congestion, and œdema of the adenoid (glandular) follicles of the organ. Not uncommonly ulcerations occur, and the resulting scar is one of the most important factors in the subsequent development of appendicitis by causing a stricture in the lumen of the appendix, obstructing the drainage of the organ, thereby favoring the retention of irritating material. Influenza exerts an influence from the intestinal lesions to which it gives rise.

The most important predisposing cause of appendicitis is the fact that the appendix has already been the seat of one or more attacks of the same affection. The seemingly greater number of cases of appendicitis observed in recent years is not that the disease has been on the increase, but rather that a greater refinement in diagnosis has rendered physicians more skilful in pronouncing the true nature of the malady, which in former years was variously styled inflammation of the bowels, peritonitis, gastritis, obstruction of the bowels, etc. The factors that operate to render the appendix less resistant than other portions of the intestinal tract to the onslaught of bacteria and other determining causes are several. The blood supply becomes defective because of the liability to partial or complete obstruction of the blood channels as a result of kinking, twisting (*volvulus*), or external bands of adhesions, etc., secondary to primary inflammation of the appendix. Disturbances of circulation, and hence of nutrition, are also produced by active and sometimes ineffectual muscular efforts of the appendix to rid itself of fecal concretions or even inspissated fecal matter. Defective drainage, which has been referred to, is of great importance in the pathogenesis of appendicitis because of the anatomical and physiological peculiarities of this organ. The average length of the appendix is about 8 to 9 cm. (3½ inches), while the diameter is only 3 mm. to 5 mm. (⅛ to ⅕ inch). Therefore in such a long narrow tube free drainage is not favored. The peritoneal covering forms what is known as the meso-appendix in such a manner as to draw the appendix into a curve and thus aid in any angulation resulting from disease. As additional factors of importance are the relatively large extent of mucous membrane presented by the appendix and the large amount of lymphoid (glandular) tissue, not only in the neighborhood of the valve-like opening into the cecum, known as Gerlach's valve, but also scattered through the wall of the appendix. The latter is of especial significance in view of the proneness of adenoid tissue throughout the body to inflammation when subject to even slight irritation by bacteria and their poisons. An analogous condition may be observed in the tonsil, which is so frequently invaded by bacteria with a resulting tonsilitis (quinsy). Owing to this similarity the appendix has frequently been called the «abdominal tonsil.» In considering the symptomatology of the two forms of appendicitis — the acute and the chronic — it must be borne in mind that it is not always possible to determine the extent of disease which has actually taken place in the appendix from the clinical manifestations. While it is true that, in general, the clinical symptoms become more marked with the increase in the severity of the appendicular and peritoneal lesions,— that is, when perforation, abscess, or gangrene supervene,— it is also a fact that remission of all symptoms may occur, and yet the disease be progressing to a fatal termination. It is likewise a fact that the symptoms suggestive of perforation of the appendix with abscess formation in one patient, may arise in another patient in consequence of the development of an abscess without perforation of the organ. It is better therefore to consider acute appendicitis as a clinical entity. Similar reasoning obtains with regard to chronic appendicitis, although in the latter the questions requiring solution are less complicated.

Acute Appendicitis.— There are three symptoms of acute appendicitis so constant and, when associated, so characteristic of the disease that they are designated the «three cardinal symptoms.» These are pain, tenderness, and rigidity of the right lower quadrant of the abdominal wall. Pain is the initial symptom and usually develops suddenly in an individual previously well. At the onset of the affection the pain is paroxysmal or colicky in character, coming in storms with intervals of rest, in which respect it simulates an attack of acute indigestion. The location is at first centered about the umbilicus, or the pit of the stomach, later becomes diffused all over the abdomen, and finally becomes localized to the right iliac fossa. In recurring cases the initial pain of the later attacks is often referred immediately to the right iliac fossa. The pain of appendicitis may, however, be referred to any region of the abdomen. It is a lack of knowledge of this fact that has lead to many errors of diagnosis in acute abdominal affections. The location of the pain depends to a great extent upon the position and direction of the appendix. For instance, with an appendix lying behind the cecum and pointing upward until its tip nearly reaches the gall-bladder, symptoms are produced resembling very closely those induced by affections of the latter organ. In other cases pain is felt upon the left side of the abdomen and denotes that the appendix occupies a left-sided position or that it hangs into the pelvis. These examples will draw attention to the statement that the pain in appendicitis will depend upon the direction and position of the appendix. Tenderness upon pressure is one of the most valuable and constant signs of appendicitis. It is always present, but, unlike the subjective symptom, pain,

is limited first to the site and position of the appendix. To elicit this symptom the pressure should be made in as light and delicate a manner as possible. The open hand should be laid over the tender area and the fingers gently depressed, ceasing as soon as the patient complains of pain. It should be remembered that the appendix may be distended with pus and on the verge of rupture, and any undue roughness in palpation might endanger the life of the patient. A celebrated German surgeon has truly said that «many a doctor who has sufficient practice and experience nevertheless never learns to palpate, since lightness of hand is wanting in him.» It is a good plan to begin to palpate over on the left side away from the seat of pain, and gradually approach that region. As complications arise the point of tenderness may vary; for instance, in those cases previously referred to where the appendix occupies a pelvic position, the point of greatest tenderness will usually be found to the left of the median line. In such a location of the appendix where the disease has advanced to a stage when an abscess has formed in the pelvis, a vaginal or rectal examination detects a point of resistance on the right side with more or less marked tenderness. The third cardinal symptom is rigidity of the right side of the abdomen and particularly of the rectus and other abdominal muscles. It is the most constant symptom of the three and appears shortly after the onset of the attack. It varies in degree in different cases, but is generally well marked, and is most intense over the site of the inflamed appendix. The variation observed ranges from rigidity so slight as to be barely appreciable up to a condition absolutely precluding any palpation, and to which the term «board-like» rigidity is applied. The degree of rigidity is usually in direct proportion to the severity of the lesion, but not invariably so. When the peritoneal cavity becomes involved with the development of peritonitis the entire abdomen becomes rigid and board-like, followed by distension or tympany from paralysis of the intestines. While the three cardinal symptoms are the most important indications of acute appendicitis there are other clinical manifestations that are more or less constantly present and are of value in aiding in the formation of a diagnosis. Of these there should be noted disturbances of the gastro-intestinal tract (nausea and vomiting, etc.), elevation of the temperature, increased pulse and respiration rate, changes in the urine, etc. Nausea is a nearly constant symptom in appendicitis and usually coincides with the initial pain; it may be followed by vomiting, which at first consists of the gastric contents, then of bile or bile-stained fluid, and finally, if septic peritonitis develops, of the contents of the intestines. Such a condition, when not seen early, has frequently been mistaken by the family physician for intestinal obstruction.

In cases of appendicitis which progress rather rapidly to peritonitis, with the marked nausea and vomiting characteristic of such a condition, the pain suffered is apt to be severe. The attending physician, often following the promptings of the patient, administers the too-convenient hypodermic of morphine, relieving the patient, but at the same time masking the symptoms and rendering the task of the surgeon called in for consultation an exceedingly difficult one. The giving of morphine for the relief of pain in appendicitis is a pernicious habit. Nausea and vomiting rarely persist after the pain has become localized to the right iliac fossa, though in some unfavorable cases vomiting may be continuous and uncontrollable. The condition of the bowels previous to the attack of appendicitis is very variable. In the majority of cases constipation is observed, and such sluggishness may be directly traceable as an etiologic factor of some importance. But there are many cases where diarrhœa ushers in the attack, and in other instances it may alternate with constipation. Fever must not be relied upon as a diagnostic sign, as it bears no direct relation to the gravity of the anatomical lesions. While upon the onset of the disease the temperature usually rises to 101° and 102° F., it may return to normal again despite the advance of severe complications such as perforation or gangrene of the appendix. Coincident with the development of an abscess around the appendix there is usually a rise of temperature, but again in this instance such a rise is not constant. There are, finally, some cases in which the temperature continues high from the commencement to the termination of the attack, and yet the patient makes an easy recovery. The amount of fever should therefore be considered as the expression of the reaction and resistance of the individual to infection. The condition of the pulse is a more constant aid than the degree of temperature, and in this instance the quality is of more importance than the rate of speed. If the pulse is strong, of good volume, regular, and the rate proportionate to the temperature, the outlook is favorable, and *vice versa*. Variations in the respiration are not of much importance. The breathing is embarrassed in toxic states, from the distension of peritonitis, and sometimes owing to the pain induced the patient will favor the use of the chest muscles entirely. A quite characteristic position often assumed by the patient is with the right leg and thigh flexed, while the left leg remains prone and the patient demands perfect quiet. In addition there may be perspiration, a furred tongue, and a slight expression of anxiety appear upon the features. The patient will frequently complain of rectal and vesical (bladder) irritability when the appendix occupies the pelvic position. An increased frequency in urination is the usual symptom, yet there may be inability to void the urine. The symptoms which have been described are typical of the usual attack of acute appendicitis, though marked variations may occur, depending upon the position of the appendix or the presence of adhesions from former attacks. With the history of previous more or less severe attacks of abdominal colic and not necessarily referred to the appendix, a patient previously well is suddenly seized with severe pain, usually throughout the abdomen. Nausea follows and sometimes vomiting. The pain soon becomes more intense over the site of the appendix, and in a few hours this locality alone is involved. If the patient should be so fortunate as to send for his physician at this time, namely, within 24 hours of the attack, and if operation is advised and performed, recovery is practically assured. But unfortunately this is not always the treat-

ment pursued. The disease is in its earliest stages, with the inflammatory lesion confined to the appendix, and the particular sequence of events which will follow in any individual case cannot be foretold. In some cases the appendix under the influence of rest is able to eliminate the noxious materials causing the inflammatory lesions, recover its vitality, and apparently become in as good condition as before the attack: but lymphoid (glandular) tissue which has once been the seat of infection is exceedingly prone to future attacks. In still other cases the disease extends through the wall of the appendix and induces a mild peritonitis localized to the coils of intestines and tissues immediately contiguous to the appendix. With the appearance of infecting bacteria or of their poisons in the peritoneal cavity, this membrane throws out a thin fluid or serum and an exudate (lymph) which organizes into firm tissue, known as adhesions. These adhesions glue the coils of intestine surrounding the appendix together, they cause adherence of such intestines to the roof of the cavity, which is the abdominal wall, and with the aid of the omentum, a fatty apron-shaped body covering the intestines, a firm wall is formed about a cavity containing the appendix, preventing the escape of toxic materials into the general peritoneal cavity. Should the disease, under medical treatment, subside, the lymphatics and the white blood corpuscles speedily destroy the infectious material, but the adhesions too often remain and cause constant irritation. In time a period of chronicity is reached when any unusual exertion provokes a dull ache in the lower right quadrant of the abdomen. The digestion is impaired, and the bowels become sluggish in their movements from the dragging of the adhesions upon the valve between the large and small intestines. In women, the subject of chronic appendicitis with involvement of the ovary and fallopian tube on the right side, slight attacks of appendiceal colic will occur during each menstrual period, and all treatment directed against dysmenorrhœa will prove unavailing. The appendix in such cases may become obliterated into a mere fibrous cord, or, as more commonly occurs, occlusion takes place at the opening into the cecum or at the site of a stricture, and the appendix becomes distended with clear mucus. While operations upon chronic forms of appendicitis in the presence of adhesions are attended with but little risk, yet the operation itself is more tedious and the incision longer than when operation is performed in the early stages of the disease. Having dealt with the favorable terminations of acute appendicitis, there remains that far too numerous class of cases where the appendix perforates, with abscess formation and sometimes general peritonitis. If the infection of the appendix is severe enough, its walls may become gangrenous and break down with a perforation occurring into the peritoneal cavity. In this case the peritoneum usually becomes infected in advance of the perforation and enough time is gained for the formation of adhesions such as have been described. In what is known as fulminating appendicitis the progress of the disease is so rapid that no adhesions are formed, and in 24 hours or less after the onset of the initial symptoms the patient may be suffering from a violent general peritonitis. But, as a rule, the escape of purulent material through a perforation in the appendix occurs into a preformed cavity, the walls of which consist of the abdominal wall, the iliac fossa, cecum and matted coils of small bowel, and the infiltrated omentum. This cavity becomes filled with pus and a true appendiceal or peri-typhlitic abscess is formed. The amount of pus varies from a teaspoonful to a pint, or in extreme cases even more. With the formation of the abscess the symptoms change somewhat. The severe pain of the early inflammatory stage becomes more dull and sometimes is referred to the back or left side, tenderness is increased, while the rigidity is more marked. The tongue becomes coated and the breath foul, chills are rarely observed even in the presence of pus, and when present — especially a single, severe chill ushering in an attack — usually mean a gangrenous condition of the appendix. There is fever, increased pulse-rate, and the patient shows the effect of absorption of poisonous products into his general circulation. An examination of the blood shows an increased number of the white blood corpuscles (leucocytosis). Palpation of the abdomen will reveal a mass in the right iliac fossa, rounded, hard, and often tender. The patient may not complain of any pain beyond the dull ache referred to, though the act of coughing or taking a deep breath usually results in an exacerbation of pain. In some cases with an appendix deep in the abdomen and behind the cecum, an abscess can exist which cannot be palpated. When such a condition is suspected it is not safe to prod the abdomen too hard for fear of rupturing the abscess. If the pus extends into the pelvis there are the additional symptoms of vesical and rectal irritability, and a vaginal or rectal examination detects a bulging area extremely tender to the examining finger. In women and girls the effect of such a pelvic abscess is frequently disastrous. The open ends of the fallopian tubes become bathed with the pus, and either a salpingitis or occlusion of the tubes takes place. The tubes are thereby prevented from fulfilling their function of transmitting the ova to the uterus, and sterility may result. The extension of the pus upward toward the liver will cause symptoms very much resembling infectious gall-bladder disease, which will be referred to under differential diagnosis. The latter direction has resulted, in neglected cases, in an abscess beneath the liver, rupture through or behind the diaphragm, and entrance of the pus into the lung and pleural cavity from which it has been actually evacuated by coughing and expectoration. If an appendiced abscess is small recovery might occur without operation, though such a happy result is doubtful. The disease is progressive, and the pus tends to increase, and if not evacuated will frequently rupture the walls of the containing cavity, into the cecum occasionally, but more often, unfortunately, into the peritoneal cavity, with a resulting general purulent peritonitis and a nearly inevitably fatal result. In such a case the pulse increases in frequency and becomes full and strong, the face becomes pinched and anxious, eyes brighten, the mind becomes active, though delirium appears later, the abdomen slowly dis-

tends, accompanied by marked pain and restlessness of the patient. These three pathognomonic conditions, a bright eye, an active mind, and a swollen belly, indicate approaching dissolution. The distension is due to a paralysis of the bowels, and gas and feces are retained in spite of all treatment. Nausea and vomiting soon begin, the latter at first green, but later black, from emptying of the contents of the intestines into the stomach. Death rapidly follows. The diagnosis of appendicitis from other lesions of the abdominal cavity, if seen early, is comparatively easy in the great majority of cases. Particular attention must be paid to the history of the patient, and especially to the character of the onset of the illness and the earlier symptoms. While inflammation of the stomach and intestines (gastro-enteritis) has caused some confusion at times, yet unfortunately the mistake is made more often in the wrong direction. That is, a true attack of appendicitis is thought to be gastro-enteritis and treated accordingly until the appearance of an abscess with its unmistakable symptoms warns the attending physician of the true nature of the malady with which he is dealing. While the pain in both diseases may begin over the stomach (in the epigastric region) and continue over the whole abdomen, in appendicitis the region of the appendix will be tender to palpation from the onset, and this tenderness will persist and even become more acute after the general abdominal pain has ceased. Unilateral rigidity is quite constant in the beginning of the appendiceal attack, while in the gastro-intestinal disease the entire abdomen may be rigid. In certain cases of gastric ulcer, with perforation and escape of stomach contents into the peritoneal cavity, the shock is more marked from the onset, while the beginning and the more severe symptoms will be found in the upper abdomen. Ulcer of the stomach is much more common in women than men, and often gives symptoms which can be recognized long before the ulcer has advanced to the stage of perforation. In enteritis, or inflammation of the bowels, and particularly when poisonous food products have been eaten, the symptoms produce early and often marked shock. In the summer months iced drinks are a frequent cause of this complaint. About 18 hours after the dietary indiscretion there will be marked general abdominal pain, diarrhœa, chilliness, perspiration, and a feeling of great weakness. In severe cases the depression may be so pronounced as to cause death (acute ptomaine poisoning). The greatest area of tenderness will be found about the centre of the abdomen, and careful palpation of the appendix region may find this organ not enlarged or tender.

Mention was made earlier in this article of the symptoms produced by inflammation of an appendix behind the cecum and pointing upward toward the gall-bladder. In such instances the symptoms produced resemble very closely those due to inflammation of the gall-bladder and sometimes the two diseases cannot be differentiated with certainty. But as both affections require surgical intervention to effect a permanent cure, and as the incision in both instances is made in nearly the same place, the failure to make a correct diagnosis is not detrimental to the patient. The pain in the gall-bladder affection, if referred, will cause a dull pain in the region of the liver and then upward to the right shoulder blade. Tenderness is limited to the gall-bladder region and is a very important symptom if the rigidity of the right rectus muscle does not prevent palpation. The appearance of jaundice, or the well-marked gallstone colics, would decide the diagnosis. Later in the progress of the disease, the infection of the gall-bladder may produce pus, or empyema, as it is called, and the gall-bladder can be palpated as a round, tender, and firm mass beneath the edge of the ribs and moving with respiration. An appendiceal abscess would rarely reach as high as the costal margin without implication of the right iliac fossa, and in a high position might be mistaken for a ruptured gall-bladder following empyema. In such a case the diagnosis would be nearly impossible and immaterial, as the treatment necessitates an operation. Neither an infected gall-bladder nor an appendix should ever be allowed to advance to the purulent stage without an operation being advised. Inflammation of the fallopian tubes has been mistaken for appendicitis and *vice versa,* particularly when the tube leaking into the pelvic peritoneum causes a localized inflammation of that membrane. With the knowledge that the appendix frequently occupies the pelvis and may lie adjacent to the tube, the exact diagnosis of acute appendicitis from acute salpingitis may be difficult, and in chronic cases even more so. From the close proximity to each other which the two organs may hold, the tube may be infected from the appendix or the latter may become involved secondarily from a pyosalpinx (pus in the tube). This complicates the differential diagnosis still further. If a history of specific infection can be obtained with symptoms indicating the commencement of the disease in the lower part of the abdomen, and a vaginal examination showing induration of the vault with tenderness to pressure on either side of the uterus, the diagnosis may reasonably be made of salpingitis. A number of other diseases may be suspected in deciding upon a diagnosis. Among these may be mentioned extra-uterine pregnancy, some kidney affections, ovarian cysts, intestinal obstruction, typhoid fever, pancreatitis, etc. The nature of this article does not warrant the full discussion of these affections. The treatment of appendicitis has been a mooted question for some time, and it has only been within the last few years that the medical profession has accepted the dictum of those whose experience with the disease has been the greatest, that appendicitis is a surgical disease. The soundness of this teaching rests upon the fact that it is impossible to foretell in any individual case what the outcome will be, and what case will terminate favorably, or which will progress to perforation or gangrene, and the attendant peritoneal and other complications and sequelæ. It is essential that physicians appreciate the importance of early operation, as although there may be a few patients who for various reasons will refuse operation, the majority will depend upon the attending physician for advice and accept the treatment which he advocates.

The mortality of the early operation, before the peri-appendicular structures have become involved, is *nil,* barring accidents, and the incision

in the rectus muscle can be so closely approximated that the abdominal wall is not weakened in the slightest by the operation. The peritoneum, sheath of the rectus muscle and skin, are usually sewed up in tier suture,— that is, in layers,— and the resulting scar about two inches long can barely be perceived after the lapse of several years. As the disease progresses the mortality increases in direct proportion to the extent to which the peri-appendicular structures have become involved. When an abscess develops, the search for the diseased appendix is difficult and often dangerous, and many surgeons simply evacuate the pus cavity and establish drainage. But the presence of a necrotic appendix is a constant menace, frequently causing secondary pus collections which may result fatally in the end. In all cases where pus is found the employment of drainage is necessitated. This means that sterile gauze must be so disposed that the purulent material is caught up and carried off by capillary drainage and the abscess cavity forced to heal from the bottom upward, avoiding «pocketing.» The course of these cases is tedious and the convalescence prolonged. The dangers incident to acute appendicitis with abscess are attendant with great risk to life. The most dreaded is peritonitis with invasion of the entire peritoneal cavity by the purulent and infectious products due to rupture inwardly of the abscess. Nearly every patient developing general peritonitis from an appendiceal abscess will die in spite of the most careful treatment and skilful operation. In advanced stages of the disease, when the appendix becomes necrotic and gangrenous, the cecum will frequently be implicated and be so diseased that the removal of the appendix cannot be followed by closure of the wound in the cecum. In cases of this character gauze must be so placed as to isolate the fistulous opening from the general peritoneal cavity, hoping that, by granulation, spontaneous healing of the bowel opening will take place; but this does not always follow, and in such instances the hole in the cecum becomes a fecal fistula, discharging the contents of the bowel through the wound in the side. Fistulæ require very frequent dressing, heal slowly, and are extremely annoying and disgusting to the patient. A third complication which may result in abscess cases is intestinal obstruction. Earlier in this article the way in which adhesions form was described. They are nature's barriers against infection, but sometimes prove a veritable boomerang. The author has more regard for the results of the aseptic scalpel of the surgeon administered at the opportune season than he has for nature's attempts to cure. It is well known that after burns of the hands the resulting scar tissue will cause contraction and deformity of the fingers. The adhesions uniting the coils of intestines together to prevent the spread of infection may encircle the bowel, and, contracting, occlude its lumen, obstructing the flow of bowel contents and necessitating a second operation the mortality of which is quite high. Finally, if convalescence is uninterrupted, the wound slowly healing by granulation, the resulting scar is quite weak and nearly always results in a hernia (rupture).

In consideration of the facts that the course of appendicitis can never accurately be foretold, and that the dangers resulting from delay in operation are many and severe, the following outline of treatment is justified from present knowledge of this disease: Upon the appearance of severe pain in the abdomen, with the maximum intensity over the region of the appendix, nausea, or vomiting, and a point of tenderness in the right iliac fossa, the patient should be placed at rest, all food withheld, and the family physician sent for. When the attending physician has made the diagnosis of appendicitis there is no treatment to be discussed save operative interference. Whether the operation should be performed immediately will depend upon the extent of peritoneal involvement, but this question should be decided by the surgeon called into consultation and in whose hands the management of the case belongs. In those fatal cases which have been followed by a reopening of the wound a study of the ascertained conditions is of great interest. When death has taken place from a rapid septic poisoning or toxemia the abdomen may show nothing except some thin cloudy fluid in the pelvis and congestion of the peritoneum covering the intestines, giving them a «scalded» appearance. In the abscess cases the right iliac fossa is found filled with a green purulent exudate adhering closely to the groin and intestines. There may be small quantities of pus which have formed since the operation. If death does not occur for several days after operation, and nature fails to check the spread of the disease, this purulent exudate may reach from the liver to the pelvis with infection of the portal vein, liver, and of the lymphatics behind the peritoneum. With extensive leakage the entire peritoneal cavity may be filled with a foul-smelling, greenish-colored pus, with gangrene of the cæcum.

John B. Deaver, M.D.,
Specialist, Philadelphia, Pa.

Appenzell, ä'pĕn-tsĕl, a canton of Switzerland, wholly enclosed within the territory of the canton of St. Gall, and, though covering an area of only 162 square miles, divided into two independent portions, Ausser-Rhoden, or Outer-Rhodes, which is Protestant, and Inner-Rhoden, or Inner-Rhodes, which is Catholic. It is an elevated district, traversed by branches of the Alps; has large tracts of rich pasture-land and extensive forests of pine, and is watered by the Sitter and by several smaller affluents of the Rhine. The climate is cold, but healthy. Glaciers occupy the higher valleys. Flax, hemp, grain, fruit, etc., are produced, but the wealth of Inner-Rhodes, the more elevated division of the canton, lies in its numerous herds and flocks: that of Outer-Rhodes in its manufatures of muslins, gauzes, cambrics, and other cotton stuffs. The construction of railways has now made the canton more accessible, and great numbers of strangers flock hither annually to take advantage of the whey-cure establishments of Gais, Weissbad, Gonten, Heiden, and Heinrichsbad. The inhabitants speak a peculiar dialect, which even those who are well acquainted with Swiss-German have great difficulty in understanding. The town of Appenzell (German, *Abtenzelle*, abbot's cell), is the capital of Inner-Rhodes, beautifully situated on the Sitter, with 4,369 inhabitants. Trogen, with 2,578 inhabitants, is the capital of Outer-Rhodes. Schools

are numerous, and education widely diffused. The division between the Protestant and Catholic portions of the canton has existed since 1597. They have only one vote between them, and send deputies to the federal assembly in turn. Pop. (1900), Outer-Rhodes, 55,281; Inner-Rhodes, 13,499. The former is one of the most densely-peopled parts of Europe, its population being equal to more than 500 per square mile. See Richman, 'Appenzell' (1895).

Ap'percep'tion, a psychological term referring to higher consciousness. Until recently there has been considerable confusion among English and American writers on psychology as to the meaning of the terms perception and apperception. To point out the source of this confusion requires a brief history of the term apperception. The word was first used by Leibnitz in connection with his philosophy of "windowless" monads. With him every human soul is a monad which develops by an inner unfolding. When this development reaches the point of clear self-conscious being it attains what he calls apperceptive consciousness. If, on the other hand, the development is only partial, if its states are vague and only partially self-conscious, the monad has attained the level of perceptive consciousness. Thus for Leibnitz the terms perception and apperception designated simply different degrees of clearness and distinctness of consciousness, with no reference whatever to the apprehension of external things. In fact the theory of Leibnitz rendered any such use of the terms impossible. In more recent German psychology the term perception has been dropped and that of apperception retained as an expression of all the higher forms of clear consciousness. There is, however, one important exception to this. Wundt has retained both terms and attempted to restore to them their Leibnitzian meaning without, of course, committing himself to Leibnitzian monadology. Mental processes which are clear and distinct and are also under the control of volition are called by Wundt processes of apperception. But when the mental act is merely association in character and not directly controlled by volition, or when it is obscure, Wundt calls it an act of perception.

The philosophy of Herbart doubtless, more than that of any other German writer, has brought the term apperception into prominence in American psychology. If we consider his system we shall find that here again the terms perception and apperception mark different degrees of clearness and completeness of the forms of mental activity. With Herbart all mental processes are but the interactions of ideas. When a new idea enters the mind it causes a connection among the ideas already present. It disturbs the equilibrium. It is welcomed by the ideas akin to it, and opposed by those which are not. When it finally becomes adjusted and settled into its proper position among pre-existing ideas the new relation thus brought about is the result of apperception. Coming over to English and American psychology we meet with that difficulty and confusion referred to above. This confusion had its origin in the fact that in translating the Leibnitzian terms perception and apperception into English these same identical terms were used, regardless of the fact that in our psychology we had already a term, perception, which had acquired a fixed and definite meaning. The English word already in use stood for the recognition of objects through the senses, and this is still its meaning. Hence it stands for the clear and self-conscious recognition of things as well as the vague and imperfect apprehension of them. The term perception brought over from German psychology, and the same word already in use, thus stood for widely different meanings, and hence the confusion. The Germans have a wholly different word (*wahrnehmung*) for what we mean by perception, and consequently they cannot understand our difficulty. The result is that we have all along used the terms perception and apperception as though they distinguished wholly different mental activities instead of marking only different degrees of the same processes, as they actually do. Apperception is only clear and self-conscious perception. It involves in a highly complex way the various mental processes of memory, imagination, judging, inferring, etc., when these processes are clear and self-conscious. A full treatment of apperception therefore requires that these processes be taken into account. It is only necessary here to indicate briefly something of the pedagogical bearing and value of the term. Mainly through the influence of the so-called Herbartian movement in America, this term apperception has centered attention upon, and emphasized the importance of, the processes involved and the conditions requisite for the successful acquisition and assimilation of new knowledge with that which has already been learned. As the bodily organism separates and assimilates only such elements of the food taken into it as are needed for its growth and repair, so in a somewhat similar manner does the mind select and appropriate only such of its presentations as manifest a certain kinship to what is already consciously and vitally present, and rejects the rest. Elements wholly foreign to the mind's present stock of ideas escape it altogether. We must therefore learn the new by means of the old. Hence before presenting the new it is necessary to call up and make alive, by arousing interest and curiosity, those ideas and materials of knowledge that by similarity or other bond of relation will best serve for the ready reception and complete assimilation of the truth or fact to be taught. The goal of intellectual development is mainly the acquisition of clear, distinct, and adequate general conceptions, and the ability to make correct application of these to new particulars as they arise, or to see in each new fact the old in disguise.

In the development of such general conceptions, two stages are recognized which may be appropriately designated by the terms perception and apperception of German psychology, if these terms be employed without reference to whether the mental facts considered are externally or internally derived. The process in the first stage is for the most part involuntarily and unconsciously directed, in the second it is voluntary and self-conscious. The process is not, however, first, sense impression, then percept, concept, judgment, and reasoning in turn, each leaving off where the next higher begins. It dates its origin far back in the mental history of each individual, and all along in actual experi-

ence, sensing, perceiving, conceiving, judging, etc., are inextricably joined in one indivisible movement of thought-development. To use James' expressive phrase, the infant's consciousness is a "big, blooming, buzzing confusion." This is the child's world. It is not, however, a world with which he can be satisfied. It must be broken in pieces and continually made over again. Chaos must be made cosmos, the irrational must become progressively rational. In fact, to rationalize the "big confusion" becomes the great and never-to-be-finished work of education and of life. Therefore the manner of this rationalization is of especial interest to the teacher. The "confusion" is not monotonous. It is not always the same. There is change. Certain elements come and go and some of them return again. By repeated recurrence these elements come to stand out in the foreground of the dark "confusion." Some of them are uniformly repeated together simultaneously or in close succession. These consequently become associated and form the basis of perception. Perception occurs when the presentation of one element immediately calls up the others belonging with it in the unity of consciousness which these elements represent. The presented element or sensation becomes the sign to which the mind at once adds the proper interpretation and accompaniment. The richness of the interpretation depends upon the mind's present attitude and condition, and its past experiences with the object presented. In other words, in all perception there is more or less of apperception.

Bibliography. — Leibnitz, 'New Essays' (1896); Logek (Stuttgart 1893); Stout, 'Analytical Psychology' (1896); McMurry, 'General Method' (1891); De Genno, 'Essentials of Method' (1899); Herbart, 'Text-Book in Psychology' (1891); Wundt, Grundzüge der Physiologischen Psychologie' (1893); Wundt, 'Outlines of Pschology' (1897); Lange, 'Apperception: A Monograph in Psychology and Pedagogy' (1893).

CLOYD MACALLISTER,
Yale University.

Appert, a'pār, **Benjamin Nicolas Marie,** a French philanthropist prominent in educational matters: b. in Paris, 1797; d. 1847. He made a careful study of prison conditions, spending much time in this pursuit, his researches being published in his 'Journal des Prisons' (1825-30). He was much opposed to solitary confinement and is said to have taught 100,000 soldiers to read and write. Besides the 'Journal' he published 'Dix Ans à la Cour du Roi Louis Philippe' (1846), and 'Conférences contre le Système Cellulaire.'

Appert, a'pâr, **Nicholas.** a French scientist, brother of Benjamin Appert (q.v.): b. 1750; d. 1841. His method of preserving food without chemicals is given in his 'Art of Preserving Animal and Vegetable Substances' (1811). It is the familiar method of placing the article to be preserved in a can after heating, and then hermetically sealing it, and for his invention he was awarded a prize of 12,000 francs from the French government.

Ap'petite, a term in its widest sense denoting the natural desire for gratification, either of the body or the mind; but generally applied to the recurrent and intermittent desire for food. A healthy appetite is favored by work, exercise, plain living, and cheerfulness; absence of this feeling, or defective appetite (*anorexia*), indicates diseased action of the stomach, or of the nervous system or circulation, or it may result from vicious habits. Depraved appetite (*pica*), or a desire for unnatural food, as chalk, ashes, dirt, soap, etc., depends often in the case of children on vicious tastes or habits; in grown-up persons it may be symptomatic of dyspepsia, pregnancy, or chlorosis. Insatiable or canine appetite or voracity (*bulimia*), when it occurs in childhood, is generally symptomatic of worms; in adults common causes are pregnancy, vicious habits, and indigestion caused by stomach complaints or gluttony, when the gnawing pains of disease are mistaken for hunger. See DIETETICS; DYSPEPSIA.

Appiani, ä'pe-ä'ne, **Andrea,** an Italian painter: b. in Milan, 23 May 1754, of noble but poor family; d. in 1817. He visited Rome three times in order to penetrate the secret of Raphael's style of fresco-painting, and soon excelled in this art every living painter in Italy. He displayed his skill particularly in the cupola of Santa Maria di S. Celso at Milan, and in the paintings representing the legend of Cupid and Psyche, which he prepared for the walls and ceiling of the villa of the Archduke Ferdinand at Monza (1795). Napoleon appointed him royal court-painter, gave him the order of the Legion of Honor and that of the Iron Crown, and made him member of the Italian Institute of Sciences and Arts. Appiani painted afterward almost the whole of the imperial family. His best works are the fresco-paintings on the ceiling of the royal palace at Milan, allegories relating to Napoleon's life, and his 'Apollo with the Muses,' in the Villa Bonaparte. Almost all the palaces of Milan have fresco-paintings by him.

Ap'pian of Alexandria, the governor and manager of the imperial revenues under Hadrian, Trajan, and Antoninus Pius, in Rome. He wrote a Roman history, from the earliest times to those of Augustus, in 24 books, of which only 11 have come down to us. It is written in Greek, in clear and simple style; but it is little else than a compilation, characterized by many inaccuracies and absurd blunders. The best modern edition is that of Schweighäuser.

Ap'pian Way, a famous Roman highway leading from Rome to Capua by way of Bovillæ, Aricia, Terracina, Formiæ, Minturnæ, Sinuessa, etc.; called by Statius *Regina Viarum,* the Queen of Roads. It was made by Appius Claudius Crassus Cæcus when he was censor, 313 B.C., and afterward extended to Brundusium by way of Beneventum. It was paved with hexagonal blocks of lava, exactly fitted to one another, resting on an admirable substructure of considerable depth, and there may still be seen, particularly at Terracina, important remains which prove its excellent workmanship. See ROADS AND HIGHWAYS.

Ap'pius Clau'dius Cras'sus, a Roman patrician, of the family of the Claudii. In 451 B.C., when the decemvirs were appointed to compose a complete legal code for Rome (afterward known as the Laws of the Twelve Tables), and to wield the supreme power in the state for a

year, Appius Claudius was chosen one of the ten, and when the office was continued for another year he was re-elected. As he and some of his colleagues had ruled in a very tyrannical manner, the people had become incensed against them, and the following circumstances led to their overthrow. Appius Claudius had conceived an evil passion for a damsel named Virginia, the daughter of Lucius Virginius, a respected plebeian, and at his instigation Marcus Claudius, one of his clients, claimed Virginia as the daughter of one of his own female slaves and offered to prove this even to the satisfaction of her reputed father, while Appius Claudius decided that in the meantime she should remain in the custody of the claimant. This decision being directly contrary to law, and Icilius and her uncle Numitorius having exposed the decemvir's criminal designs, the aspect of the people became so threatening that he was forced to leave the maiden in the hands of her family, declaring, however, that he would finally settle the case next day. Virginius, hastily summoned from the army, appeared with his daughter next day in the forum in mourning robes and appealed to the people; but Appius Claudius, attended by a strong guard, again adjudged her to M. Claudius. Unable to rescue his daughter, the unhappy father snatched a knife from a butcher's stall and plunged it into her bosom, saying, "There is no way but this to keep thee free." Virginius escaped to the camp and with the army returned to Rome, demanding revenge. The decemvirs were deposed by the indignant people, and the government by tribunes and consuls restored 448 B.C. Appius Claudius died in prison or was strangled, while Marcus Claudius was banished.

Ap'ple, the name given to a low round-headed tree (*Pyrus malus*) of the natural order *Rosaceæ*, with compact clusters of flowers which appear with the thick woolly short-stemmed leaves and followed by fruits botanically known as pomes. It is a native of south-eastern Europe and contiguous Asia, whence it has been spread by man as a cultivated plant to all temperate climates of the globe. It has been more or less hybridized with its close relative, *P. baccata*, the well-known Siberian crab, a smoother, more wiry species coming from a somewhat more northeastern district. This latter species has thinner, smoother, longer-stemmed leaves and fruit-stems than the other; the deciduous calyx of its smaller, harder fruits is also a striking difference, the calyx of the other being permanent. Certain hybrids of these two species are known as *P. prunifolia*. Besides these Old-World species and their progeny there are two American species, *P. coronaria*, of no culinary value, but of use as an ornamental plant, and *P. ioensis*, a promising species which, by crossing with *P. malus*, has given rise to the hybrid race, *P. soulardi*, remarkable for its hardiness. The term crab is loosely applied to small, long-stemmed apples as well as to varieties of the two leading species mentioned.

Commercial Importance.— If not the leading fruit of the world, a status few will question, the apple is certainly the most important fruit of the temperate zones, a rank which it merits for the following reasons: When the market is glutted it can be disposed of in more ways than any other fruit (see BY-PRODUCTS, below); a large number of its varieties keep well, withstand shipment to and sell well in distant markets; the tree readily adapts itself to great extremes of climate, soil, and other conditions. It is, in fact, the only fruit that has passed the bounds of luxury and become a staple article of food except in the tropics. Its range extends in the northern hemisphere from Scandinavia to the mountainous parts of Spain, from New Brunswick to the high lands of Georgia, and from British Columbia to the mountains of Mexico. The great apple-producing countries of the world are the United States, Canada, Australia and adjacent islands, Russia, and Germany. In America the principal apple districts are Nova Scotia, New England, New York, Pennsylvania, Ontario, Ohio, Michigan, Kentucky, and the central western States. Other less extended or younger districts are the Piedmont sections of Virginia, West Virginia, North Carolina, Tennessee, etc., the Pacific Coast States, and British Columbia.

From the eastern regions a steady export trade has been growing, mainly with British ports, and when the eastern crop is short, Pacific coast apples are shipped across the continent in large quantities to eastern markets. According to Bailey a full crop of the United States and Canada "of all kinds and grades, is probably not less than 100,000,000 barrels." The Twelfth Census Report of the United States gives the number of trees standing in 1900 as follows: Missouri, 20,040,399; Illinois, 13,430,006; Ohio, 12,952,625; Kansas, 11,848,070; Pennsylvania, 11,774,211. The total number of apple trees in orchards at that date was 201,794,764 as compared with 120,152,795 in 1890. When compared with the figures of the previous census the extension of orchard-planting seems to be greatest in the central western States, especially in Missouri. The crop reported for some of the States in 1899 (see Census Report) are as follows: New York, 24,111,257; Pennsylvania, 24,060,651; Ohio, 20,617,480; Virginia, 9,835,982; Illinois, 9,178,150. The crop of New York and Pennsylvania was 34.1 per cent of the total crop of the United States — 175,367,626 bushels in that year. In 1889 the crop was 143,105,689 bushels. The report further states: "The apple has a decided primacy among American fruits. Of the orchard trees reported in 1900, 55 per cent were apples, and of the bushels of fruit reported, 82.8 per cent were of that variety. In 10 years the number of apple trees increased more than 80,000,000, yet the number of other fruit trees increased so much faster that the apple trees, which constituted 62.1 per cent of all in 1890, were only 55 per cent in 1900. . . . The apple crop of 1899, taking the country as a whole, was more nearly a normal one than was that of any other orchard fruit. Further, the average production of apple trees, being larger than that of other trees, affects the total in such a comparison . . . more than does the number of trees. The apple increased its proportion of the total production of orchard fruits from 76.3 per cent in 1889 to 82.8 per cent in 1899.

Varieties.— In addition to productiveness, an essential to the value of any food plant, the 12 points mentioned and explained below should be looked for in an apple variety. Of course all 12

1. An apple orchard in Delaware. 2. A Baldwin apple orchard in New York.

of these qualities cannot be found greatly developed in a single variety because some are in a measure antagonistic, but by keeping these points in mind the prospective orchardist may avoid planting a variety that would not meet his own expectations or the market demands. (1) Richness, dependent upon the relative proportion of sugar to malic acid. When these are deficient in amount the fruit is insipid, but each may be present in large amount without making the fruit pronouncedly sweet or tart to the taste. Many tart apples contain more sugar than some of the so-called sweet apples. In ripe specimens of improved varieties the range of acid is from 0.19 to 1.11 per cent, and of sugar from 10 per cent or even less in poor sorts to 14 per cent or somewhat more, the usual range being from 11 to 13 per cent. (2) Flavor, a quality distinct from the taste of acid and sugar, and, like perfume, dependent upon minute quantities (seldom more than 0.5 per cent) of a volatile oil. A highly perfumed apple is, however, not necessarily highly flavored. (3) Firmness not sponginess, crispness not hardness, tenderness not softness, meltingness not juiciness are dependent upon cell structure. (4) Color is often of more importance in the uneducated market than form, size, richness, and flavor combined. It is an unsafe index of the last two qualities, except that, as a rule, well-colored specimens are superior to poorly colored ones of the same variety. Color varies in all varieties with season, soil, management, etc. The favorite color in the general market is red. (5) Form: a nearly globular shape is most desirable because fruits of that form pack better without bruising than other forms. (6) Size and uniformity. In general, a diameter of about three inches and a weight of six or eight ounces is preferred, and a variety producing such as the bulk of its crop will usually, on account of the lessened necessity for grading, be more valuable than another variety of equal productiveness but with widely varying size of fruit. (7) Smooth, tough, but thin skin resists insect and fungous attacks, injuries in handling and shipping, and are more economical with respect to waste. (8) Small core and few seeds, save waste. (9) Maturity: The commercial variety should be ready to harvest all at once. (10) Firm adherence to the tree; self-evident. Defectiveness in this respect may be due to attacks of enemies. (11) Culinary qualities: of prime importance in commercial varieties because such are used mainly for cooking. Sweet varieties usually make insipid pies but good baked apples; tart varieties make best pies and sauce. (12) Good-keeping is not dependent solely upon firmness but is usually associated with locality, climate, soil, etc., as well as with the variety and the stock upon which it is grown.

Another matter of importance in the selection of varieties of apples, and even more markedly of pears, is the determination of the fertility of the blossoms. Sterility, indicated by annual dropping of the fruit, may result from one or a combination of the following causes. Impotence of the pollen or the pistils, or the premature ripening of one or the other; injuries to the blossoms by fungous attacks, rain, frost, or continued cool weather or other cause more or less beyond the grower's control. On the other hand, it often results from impotence of the pollen to fertilize the pistil of the same variety and is noticed when trees stand singly or in blocks of one variety remote from other varieties. This may be obviated by the grower, who should plant varieties that blossom at the same time in proximity, usually in alternate rows through the orchard, or by grafting such in orchards already set. A practice resulting from this and the varying maturity of varieties with respect to fruit-bearing is the planting of «filler» trees in permanent orchards. The fillers are quick-maturing varieties of usually upright growth and small size, which are set alternately with the slower-growing more-spreading permanent trees, and cut out when crowding seems to threaten. For such practice four varieties are usually selected, two fillers and two permanents, each pair blossoming at the same time. Each pair is placed alternately with the other and each member of the pair alternately with its partner. Trees in such orchards are often planted 28 feet apart on the diagonal, so that when the fillers are removed the permanents will be left in rectangles of about 40 feet, the usual distance recommended for large-growing varieties. Some growers plant as close as 30 feet, but this is too close except for trees of small growth. No other tree fruit than the apple should be planted in an apple orchard, because no two fruits demand the same treatment, and where two are planted, one or the other, perhaps both, must suffer more or less. See ORCHARD.

Propagation.— New varieties of apples are propagated from seeds, but since seeds rarely improve upon the parent, seedlings are chiefly used to produce stocks for grafting or budding. Standard (that is, natural-sized) trees are so propagated. Dwarf trees result from grafting or budding the same varieties upon the small-growing, almost bush-like varieties, paradise and doucin, the stocks of which are produced by mound layering. Voluminous discussion has arisen concerning the relative advantages of grafting over budding, and also concerning certain methods of grafting. Opinions in the first case are very conflicting; in the latter they seem to favor the use of a small piece of apple-root as stock and a rather long scion to be set deeply in nursery and orchard in order to ensure the rooting of the scion and thus obtain a tree drawing its nourishment from its own roots instead of from the nondescript roots of the seedling stock. In northern rigorous climates very hardy varieties are selected upon which to top-work less robust sorts, thus to increase their hardiness. When the trees are set the tops must be cut back severely to balance the loss of root due to digging from the nursery and to start the head at the proper height from the ground. Formerly six feet was the usual length of trunk desired, but half that length is now preferred and in the central Western States even less. Trees with short bodies and low heads are less likely to be injured by wind and sun-scald than those with high heads and long bodies. Established unprofitable trees and undesirable varieties are often top-worked to valuable ones; not more than a third of such trees being grafted each year because of the danger of producing water-sprouts. See GRAFTAGE; PRUNING; TRANSPLANTING.

Soils, Fertilizers, etc.— Apples thrive upon nearly all kinds of soils, certain varieties being better adapted to light soils and others to heavy rather than the reverse in each case; but the great majority of the almost innumerable varieties succeed best upon medium to clayey loams, especially if they are somewhat elevated, inclined, or rolling, and in a clear, dry climate. Since air and water drainage are usually good in such places the fruit produced is generally of fine color, flavor, and size. Upon low lands and in damp climates the fruits are usually of inferior quality and the trees more susceptible to fungous attacks. (See ORCHARD.) The fertilizers demanded by apples are mainly potash and phosphoric acid. (See MANURES.) Some growers use a mixture of 100 pounds of muriate of potash to 200 pounds of 16 per cent superphosphate at the rate of 100 pounds an acre while the trees are small, increasing to 500 pounds and even as much as 1,500 pounds an acre for trees in full bearing, the amount depending upon the character and condition of the soil, and the grower's management. If cover crops (see GREEN MANURING) such as clover, vetches, or cow-peas are grown, they will supply all the nitrogen needed; indeed, if long continued or if several very heavy crops be turned under, too much nitrogen may accumulate, and recourse to a cereal crop be necessary to remove the excess. Too much nitrogen induces a sappy, easily winter-killed growth, generally at the expense of fruit-production. Lack of nitrogen is indicated by pale green or yellowish foliage. The preparation of the land does not differ materially from that for other crops such as corn or potatoes, each of which is often grown the season previous to planting in order to fit the land for the orchard. The trees may be set in spring or autumn and the cost of cultivation may be met by cropping the land for the first few years with potatoes, melons, or some other low-growing, inter-tilled crop. Annual cultivation consists in an early spring plowing followed by narrowings at intervals of two weeks and after rains that form a crust until mid-summer, when a cover crop is sown to be turned under in the following spring. Deep plowing during the first five years or so will induce deep rooting which in after years will assist in withstanding drouth and obviate the necessity of annual deep plowing. See TILLAGE.

Growers opinions differ as to the length of trunk an apple tree should have, and also as to whether there should be a main trunk above the principal lower limbs, but all agree that a few (some growers say five, four, or even three) well-placed main limbs are better than a larger number. These mains should start far enough from one another to avoid the danger of splitting when under load of fruit, and should be made to re-branch near the main trunk. Some of these latter branches should be trained upward, the others more horizontally, so as to develop a well-rounded, symmetrical top. Four or five years' careful training should so fix the character of the tree as to obviate in great measure the necessity of subsequent pruning. See PRUNING.

Insects.— Several hundred insects feed upon the apple, but the most of them are so well controlled by their enemies or by natural checks that their injuries are seldom noticed. There are, however, many that are frequently troublesome, among which the following are perhaps the most commonly destructive. In connection with the specific means of control here mentioned, the reader should refer to the general article FUNGICIDE. (1) Codlin moth (*Carpocapsa pomonella*) is perhaps the best-known and most widely distributed apple pest. The eggs are laid upon the fruit, the larvæ almost invariably entering the calyx, burrowing through the flesh and causing premature ripening. Since two or even three broods are produced in a season, the destruction of the first by spraying is of prime importance. This spraying must be done before the calyx closes, because the caterpillar's first meal must be poisoned, to accomplish which the sepals must not have closed. The destruction of culls, cores, and parings and the use of moth-traps in the windows of storage-rooms also assist in controlling the pest. (2) Apple maggot (*Tripeta pomonella*), the footless grub (one fifth inch long) of a two-winged fly, tunnels in the fruit and is especially troublesome in New York and New England, attacking thin-skinned summer and autumn varieties. Windfalls may be eaten by stock running in the orchard, and stored apples may be fumigated with carbon disulphid. (3) San José scale (*Aspidiotus perniciosus*), a minute scale insect of enormous prolificacy found upon many species of woody plants which in a few years die. When full grown it so closely resembles some of its relatives that a microscopic examination is necessary to determine its identity. When abundant, infested twigs have a somewhat scurvy appearance resembling a coating of ashes. From beneath the female scale the young appear, crawl to new feeding ground, fix themselves, and reproduce with great rapidity. It has been estimated from careful records of close observations that more than three billion scales may be produced in a single season from one female. Spraying with kerosene emulsion, lime, sulphur, and salt solution, or fumigating with hydrocyanic acid gas, are the three popular ways of combatting this pest. (4) Canker-worm, the larvæ of certain moths (species of *Anisopteryx* and *Paleacrita*), most common in the northeastern United States and adjoining Canada. They attack the leaves of apple, pear, and some other trees, entirely defoliating them when especially abundant. The wingless females crawl up the trunks and lay their eggs upon twigs or bark. The larvæ, measuring-worms, appear shortly after the foliage from which, when disturbed, they drop at the ends of silk threads. If they reach the ground they climb the trunk to resume feeding. Pupation occurs in the ground. This climbing habit of both females and larvæ, especially of the former, suggested impassable bands upon the trunk as a means of control. To be most effective these must be applied just before the females begin to climb, and since those of one species are active in the late fall and upon warm days during the winter, and those of the other in the spring, the bands must be kept in good condition during most of the year. (Consult: New Hampshire Experiment Station Bulletin, No. 85, 1901.) (5) Tent caterpillar, the larvæ of a moth (*Clisiocampa americana*), attack various trees in a large part of the United States and Canada. The eggs

are deposited in gluey-looking masses upon the twigs in summer and hatch in very early spring. The larvæ are gregarious, and spin a protective web from which they emerge to feed. When numerous they frequently strip large limbs or even trees of foliage. Gathering the eggs during the winter and cutting off the nests as soon as seen are the two most effective methods of control. Since several parasites attack the eggs of this moth, the egg masses should be kept out of doors in a place from which the parasites, but not the newly hatched worms, can escape. (6) Web worm (*Hyphantria cunea*) is a caterpillar similar in habits to the preceding, but enclosing the foliage upon which it feeds inside a web until nearly full grown, when like the former species the larvæ disperse. The eggs are laid by a moth in late spring upon the undersides of leaves near the tips of branches of many trees, bushes, and even clover. Cutting and burning is the most effective remedy. (7) The round-headed and the flat-headed borers are serious pests. They bore in the young wood, the latter mainly near the ground in the trunk, the former more frequently in the larger limbs. They are the larvæ of two beetles (respectively, *Saperda candida* and *Chrysobothris femorata*). Their presence is indicated by the presence of chip-like castings at the mouths of their burrows. The only effective means of control are cutting out the larvæ or prodding them to death in their burrows with a flexible wire. The application of repellants to prevent the laying of eggs upon the trunks is sometimes recommended. (8) Woolly aphis (*Schizoneura lanigera*) often called American blight in England and Australia, is a serious pest, especially upon young trees. Two forms of this insect appear; one above ground, the other upon the roots. The former, readily recognized by its woolly appearance, is easily controlled by kerosene emulsion; the latter is hard to fight without injuring the trees. Tobacco dust worked into the ground seems to be the most effective and least harmful remedy. Nursery stock should always be carefully examined for this pest and treated, if necessary, before being planted. (9) Bud moth (*Tmetocera ocellana*), a tiny insect, the larvæ of which appear in midsummer, pass the winter in the larval state and attack the opening buds and young leaves, over which they weave a little web in early spring, when they are most destructive. Paris green is effective.

Diseases.— Apple scab (*Fusicladium dendriticum*) is probably the most serious apple disease, since it causes the loss of much fruit and injures the appearance of much more. It appears as black spots with grayish borders on apples and pears, commonly seen on greening, snow, and yellow harvest varieties that have not been sprayed. Often the abundance of the confluent spots prevents the normal development of the fruit, which becomes lop-sided. The leaves are also attacked, but the markings are not so pronounced. Spraying with Bordeaux mixture is very effective. Rust (*Rœstelia pirata*) appears upon the foliage in early summer as orange spots more or less confluent. The fruit is also destroyed. The spores of this fungus will not germinate upon the apple but find a congenial host in the juniper or cedar, upon which they are called cedar apples (botanically, *Gymnosporangium macropus*). These, when matured in the following spring, look something like orange yellow sponge. Their spores will not germinate upon the cedar, but will upon the apple. Sometimes the fungus perpetuates itself by its mycelium, which may live from year to year upon the young twigs and buds of the apple. Destruction of the cedars and spraying are effective. Apple canker (*Nectria ditissima*) destroys the bark and younger wood, and eventually the tree, but small areas may be cut out and the wounds painted with Bordeaux mixture. In fact, since this disease gains entrance through wounds, all such should be similarly treated. Burning badly infested trees is the only means of checking the spread of this disease. Powdery mildew (*Podosphæra oxycanthæ*), a grayish growth upon the foliage, is often troublesome in the South upon young trees and seedlings in the nursery. It may readily be controlled by a standard fungicide. Bitter rot (*Glœosporium fructigenum*) appears upon the fruit as brown spots, extending until they often involve the whole apple. It may attack at any time and is especially destructive to the early varieties, more in the South than in the North. Black rot (*Sphæropsis malorum*) resembles bitter rot and is similarly controlled. See FUNGICIDE.

Harvesting, etc.— As the fruit ripens, the starch which it contains becomes changed into sugar, the leaf green is replaced by tints characteristic of the variety, the flow of sap into the fruit diminishes until the apple has attained full size and weight, when the flow practically ceases. Since the changes that now take place are mainly chemical and continue independent of the tree, the fruit may be picked. Fruit-growers agree upon this time, which they determine with each variety from experience. The fruits are still hard, but have brown seeds, and, having reached the development mentioned, may be picked by slightly twisting the stem without danger of breaking the twig upon which it is borne, thus preventing a loss of bearing-wood. Fruits gathered at this time and ripened properly are superior to those allowed to hang longer upon the tree. For best results in keeping, apples should be stored as soon as possible after picking; the temperature kept uniform and near 33° F., so as to check the ripening process; draughts avoided, since they hasten decay and increase shrivelling, hence closed packages are better than shelves; odors should be excluded.

Cost of Production, Yield, etc.— From various sources the following annual averages of cost of growing an acre of apple trees to fifteen years of age have been compiled, the orchards in each case being managed according to approved modern methods. Plowing (once). $3.50; harrowing (seven times), $3.25; spraying (Bordeaux mixture and Paris green, four times) $5.00; fertilizers, $11.50; interest (at six per cent on land worth $100 an acre), $6.00; total, $34.55. Commencing at the age of from 6 to 10 years, according to variety, there should be a gradually increasing crop. At fifteen the orchard should be in nearly full-bearing. The cost of maintaining a New England orchard in full bearing was, per acre, as follows: Pruning, $2.50; plowing, $0.90; harrowing, $1.80; picking and packing, $12.50; barrels at 30 cents, $15.00; fertilizers, $2.50; spraying, $2.00; inter-

est (six per cent on land valued at $50 an acre), $3.00; total, $40.20. This orchard produced 50 barrels of No. 1 apples, which sold for $75.00. The plowing was probably done with a gang-plow, hence its low cost. Individual trees properly cared for often produce more than 10 barrels of fruit, and one New England orchard of young Fameuse apple trees produced in 1895 700 barrels and in 1896 1,000 barrels, which netted $1.90 and $1.00 a barrel, respectively. Waugh, who quotes these New England figures, remarks: «These results are not extremes; but they were secured by men who take care of their orchards.»

By-Products.— Apple culls may be used in more ways than the culls of any other fruit crop, and each product finds a ready market, mainly at home. The better specimens are usually evaporated, the cores and peelings of such being also utilized either for cider-making or more frequently they are dried and shipped to Europe for the manufacture of certain kinds of champagne and other wines. The others are usually made into cider, which in turn may be remanufactured into jelly, apple-jack, (apple brandy, a distilled liquor) or vinegar. When cider and apples are mixed and boiled with or without sugar the product is called marmalade, and, if spices be added, apple butter. The pomace (as crushed fruit is called, especially after the expression of the juice) is washed to obtain the seeds, which are dried and used for planting.

Bibliography.— Warder, 'American Pomology,' Part I., *Apples* (1867); Todd, 'Apple Culturist' (1871); Bailey, 'Field Notes on Apple Culture' (1886); Nebraska State Horticultural Society, Vol. XXV. 'The Apple,' (Lincoln, Neb. 1894); and various reports of horticultural societies, especially of the American Pomological, Michigan Pomological, and Western New York Horticultural societies; also various works on fruit culture. M. G. Kains.

Ap'ple Bran'dy, or Apple Jack, a liquor made from the fermented juice of apples by the ordinary processes of distillation.

Ap'ple of Discord, according to Greek mythology, the golden fruit thrown among the Olympian divinities by the goddess of discord (Eris), bearing the inscription «for the fairest.» Aphroditē (Venus), Hera (Juno), and Pallas (Minerva) became competitors for it, and its award to the first by Paris so inflamed the jealousy and hatred of Hera to all of the Trojan race (to which Paris belonged) that she did not cease her machinations till Troy was destroyed. This story is introduced in Tennyson's 'Œnone.'

Ap'ple of Sodom, the title of a fruit described by old writers as externally of fair appearance, but turning to ashes when plucked. It is probably the fruit of *Solanum sodomeum,* a nightshade (q.v.) of northern Africa, which when eaten may produce delirium and even death. An American nightshade is also so called.

Ap'ple-shell, the designation of one of the large, handsomely ornamented, globose, bush-climbing pond-snails of tropical Africa and America, belonging to the genus *Ampullaria.* Some species are to be found along the southern border of the United States. These mollusks are truly amphibious, having both lungs and gills, and are thus able to breathe in water or in air, whenever disposed to exchange an aquatic for a terrestrial existence. Consult Semper, 'Animal Life' (1881).

Ap'pleton, Charles Edward Cutts Birch, an Englishman of letters: b. in Reading, England, 16 March 1841; d. in Luxor, Egypt, 1 Feb. 1879. He was graduated from St. John's College, Oxford, in 1863, studied for two years in German universities, and was appointed lecturer in philosophy at St. John's College. His best service to literature and his time was his founding the 'Academy, a Monthly Record of Literature, Learning, Science, and Art,' whose first number appeared 9 Oct. 1869. Its characteristic feature was the signing of all the critiques and leading articles with the writers' names in full, and these included men of the highest eminence in literature and science. Appleton remained editor until his death. To a volume of essays on the 'Endowment of Research' he contributed two articles: 'Economic Character of Subsidies to Education,' and 'Endowment of Research as a Form of Productive Expenditure' (1876). See J. H. Appleton and A. H. Sayce, 'Life and Literary Relics' (1881).

Ap'pleton, Daniel, an American publisher: b. in Haverhill, Mass., 10 Dec. 1785; d. in New York city, 27 March 1849. After engaging in the dry-goods business in Haverhill, Boston, and New York, he began importing English books with his merchandise. He presently devoted himself exclusively to the business of printing and publishing, and between 1830 and 1849, in conjunction with his sons, laid the foundation for the successful career of the firm still known as D. Appleton & Co. Its publications extend over the entire field of literature, and it has rendered great service in issuing the works of modern scientists at moderate prices; for example, Herbert Spencer, Tyndall, Huxley, Darwin, etc. Medical books form a special department, and Spanish books for the South American market a specialty which the firm has made its own. In *belle-lettres* and American history it has a strong list of names among its authors.

Ap'pleton, George Swett, an American publisher, son of Daniel Appleton (q.v.): b. in Andover, Mass. 1821; d. in 1878. After following the publishing business for some years in Philadelphia he succeeded, in 1849, to his father's business in New York, with his three brothers.

Appleton, George Webb, an American novelist and dramatist, now resident in London: b. in New Jersey in 1845. He is author of the novels 'Frozen Hearts'; 'Catching a Tartar'; 'Jack Allyn's Friends'; 'A Terrible Legacy'; 'The Co-Respondent'; 'A Philanthropist at Large'; 'The Blue Diamond Mystery'; 'François the Valet'; 'Rash Conclusions'; 'The Romance of a Poor Girl'; 'A Forgotten Past'; of several plays, and of 'A Hundred Years of French History, 1789–1889.'

Ap'pleton, James, an American temperance reformer: b. in Ipswich, Mass., 1786; d. 1862. He served in the American army during the second war with England, and, removing to Maine, in later years entered the Maine legislature, where in 1837 he introduced a report

which became the basis of the famous Maine Liquor Law.

Ap'pleton, Jesse, an American theologian: b. in New Ipswich, N. H., 17 Nov. 1772; d. in Brunswick, Me., 12 Nov. 1819. After his graduation from Dartmouth College in 1792 he was ordained pastor of the Congregational Church at Hampton, N. H., in 1797. He was president of Bowdoin College, 1807–19. A man of fine culture and attractive personality, he was constantly in demand as a preacher on important occasions. His daughter married President Franklin Pierce. His lectures, sermons, and other writings, with a memoir, were published by Prof. A. S. Packard, 'The Works of Jesse Appleton, D.D.' (1837).

Ap'pleton, John, an American diplomatist: b. in Beverly, Mass., 1815; d. in 1864. He was secretary of the American legation at London, 1855–6, assistant secretary of state in 1857, and minister to Russia, 1860–1.

Ap'pleton, John Howard, an American scientist: b. in Portland, Me., 3 Feb. 1844. He was graduated from Brown University in 1863 and was instructor in chemistry there 1863–89, and professor since 1868. He has been professor of chemistry at Brown. He was a member of the United States Mint Commission in 1891. His chemical text-books have been widely used, and include 'Qualitative Chemical Analysis' (1878); Quantitative Chemical Analysis' (1881); 'Chemistry of the Non-Metals' (1884); 'Metals of the Chemist' (1891); 'The Carbon Compounds' (1892).

Ap'pleton, Nathan, an American merchant: b. in New Ipswich, N. H., in 1779; d. in 1861. He started the first cotton power-loom in the United States and was one of the founders of the city of Lowell. He sat several times in the Massachusetts legislature, and in 1830 and again in 1842 was a member of Congress.

Ap'pleton, Samuel, an American merchant, well-known as a philanthropist, brother of Nathan Appleton (q.v.): b. in New Ipswich, N. H., in 1766; d. in 1853. He retired from business in 1823 and at his death bequeathed $200,000 for benevolent and scientific purposes.

Ap'pleton, Thomas Gold, an American author and artist: b. in Boston, Mass., 31 March 1812; d. in New York city, 17 April 1884. He was graduated from Harvard University in 1831 and spent much of his life abroad. A generous patron of the fine arts, he was himself an amateur painter of considerable ability. In society he was a well-known figure, being a brilliant talker with a gift of epigram. His witticism, 'Good Americans, When They Die, Go to Paris,' has been erroneously ascribed to O. W. Holmes and others. His books are: 'A Sheaf of Papers' (1874); 'Nile Journal' (1876); 'Chequer Work: Tales and Essays' (1879); 'Syrian Sunshine' (1877); 'Windfalls' (1878). His poem "Faded Leaves," was once popular. See Susan Hale, 'Life and Letters' (1885).

Ap'pleton, William Henry, an American publisher, the eldest son of Daniel Appleton (q.v.): b. in Haverhill, Mass., 27 Jan. 1814; d. in 1884. In 1835 he was sent to represent his father's firm in London, and in 1836 a permanent agency was established there. In 1838 he was taken into partnership, and upon the retirement of his father in 1848 he formed a copartnership with his brothers to continue the house of Daniel Appleton & Co.

Ap'pleton, Wis., a city and county-seat of Outagamie County, on the Fox River and the Chicago & N. W. and the Chicago, M. & St. P. R.R.'s, 25 miles southwest of Green Bay. It is at the head of navigation on Lake Winnebago and on the Green Bay waterway, on a plateau 70 feet above the river, and near the Grand Chute rapids whence it derives excellent power for manufacturing. The principal industry is the manufacture of farm implements, furniture, paper, flour, pulp, machinery, and woolen and knit goods. It is the seat of Appleton Collegiate Institute and Lawrence University (Methodist Episcopal), and has university and public school libraries, three national banks, daily and weekly newspapers, and a property valuation of over $3,500,000. Pop. (1900) 15,085.

Appoggiatura, a-pŏd'ja-too'ra, a musical term applied to a small additional note of embellishment preceding the note to which it is attached, and taking away from the principal note a portion of its time. It is expressed thus:

 and performed  Long appoggiatura invariably occurs on the beat, and short appoggiatura, now commonly styled a grace-note, is written as an eighth note with a stroke through the stem.

Appoint'ment, the designation of an individual, by the person or persons having authority so to do, to perform the duties of some office or trust. The making out of a commission is conclusive evidence of an appointment to an office for holding which a commission is required. 1 Cranch, U. S. 137; 10 Pet. U. S. 343. An appointment is usually made by one person or a limited number acting with special authority, while an election is made by all of a class. In chancery practice an appointment is the exercise of a right to designate the person or persons who are to take the use of real estate. 2 Washb. R. P. 302.

Appold, ăp'ōld, **John George,** an English mechanician and inventor of automatic machinery: b. in 1800; d. 5 Aug. 1865. He invented a centrifugal pump, a brake which was used in laying the Atlantic cable, and a process for dressing furs.

Ap'pomat'tox Court House, a village in Virginia, 20 miles east of Lynchburg. It was the scene, 9 April 1865, of Gen. Lee's surrender to Gen. Grant, an event which virtually concluded the American Civil War.

Apponyi, ŏp'pō-nyĭ, **György (George), Count,** a Hungarian statesman: b. 1808; d. 1899. He was Hungarian court chancellor in 1847 and after some years of retirement entered the Reichsrath of Vienna in 1859 and was active in furthering schemes for the welfare of Hungary, materially assisting in bringing about the union of Austria-Hungary on the present basis. His son ALBERT APPONYI, a leading member of the Hungarian diet, is one of the most eloquent orators in Hungary.

Appor'tionment, a term signifying the division or distribution of a subject-matter in proportionate parts. In relation to contracts an apportionment is the allowance, in case of the partial performance of a contract, of a proportionate part of what the party would have received as a recompense for the entire performance of the contract. But where the contract is to complete a thing for a certain sum of money or other consideration, there can be no apportionment.

Apportionment - incumbrances.— The determining of the amounts which each of several persons interested in an estate shall pay toward the removal or in support of the burden of an incumbrance.

Apportionment-rent.— A term denoting the allotment of shares in a rent to each of several persons owning it. It is also applied to the determination of the amount of rent to be paid when the tenancy is terminated at some period other than one of the regular intervals for the payment of rent.

Appor'tionment Bill, the designation of a bill adopted by the United States Congress every 10 years, and directly after the completion of the Federal census, determining the number of members that each State is entitled to send to the National House of Representatives, and providing for the necessary reorganization of the Congressional electoral districts. The number of representatives has risen from 65 in 1789 to 386 in 1900, and the number of population to each member has advanced from 30,000 to 193,175, in the same period.

Ap'posi'tion, a grammatical term implying the relation in which one or more nouns or substantive phrases or clauses stand to a noun or pronoun, which they explain without being predicated of it, and with which they agree in case: as Cicero, *the orator*, lived in the first century before Christ; the opinion *that a severe winter is generally followed by a good summer* is a vulgar error.

Ap'prehen'sion (Latin *apprehensio*, from *ad* + *prehendere*, to seize), a term employed to denote the subjective character of perception. In the philosophy of Aristotle the act of attaining direct acquaintance with any truth or object of knowledge was called θιγεῖν, which figuratively means a touching or immediate contact with truth. The scholastics translated this term by the word apprehension, which has descended with modified and extended meaning to modern philosophy. This word has accordingly been employed to designate the act or faculty (1) of perceiving anything through the senses, (2) of forming an image in imagination, (3) of conceiving without judging, the so-called simple apprehension of nominalistic logic; or (4) a relatively simple and immediate act of intellection with or without reference to an external object. In this use of the word it distinguishes this form of intellection from the more complex and elaborated forms of knowledge denoted by the words comprehension, judgment, etc. Thus, for example, when an object or event is viewed apart from other things or events, it is said to be apprehended. When brought into systematic relations with kindred objects of knowledge we say it is comprehended. Stone makes a rather important distinction between implicit and explicit apprehension. Through frequent recognition of an object of knowledge the mind acquires the ability to distinguish and identify it as a whole without apprehending any of its constituent elements. The act which thus grasps its object without conscious combination or synthesis of parts is an implicit apprehension. If attention lingers upon the object, a tendency toward multiplicity arises, the component parts become discernible, and implicit apprehension becomes explicit. In the one there is a distinctionless unity; in the other a conscious synthesis. Implicit apprehension is a form of what Prof. Ladd calls the condensation of a series and is an important aim and result of correct mental training.

Wundt distinguishes apprehension from apperception, or what we should call clear and self-conscious perception, in a very suggestive though highly figurative way. He, of course, recognizes that in a series of temporally successive ideas or mental states the one immediately present in perception has the most favorable position as regards clearness and distinctness. Likewise, in a spatial series, or in a complex of simultaneously interconnected factors present in consciousness, some factors are more favorably located than others. There is, accordingly, a state of clearest grasp in consciousness, which, when accompanied by a special feeling, is called attention. This state of clearest grasp is figuratively styled the fixation point of consciousness, or, more briefly, the inner fixation point. In contrast the whole complex psychical content is called the field of consciousness. A conscious process which passes into an unconscious state is said to pass below the threshold of consciousness. A psychical compound which enters the field of consciousness passes on to the inner fixation point, then out again into the field, and finally descends below the threshold, is an apperceived compound. But just as such compounds may enter the field of consciousness before reaching the point of fixation, so may other compounds enter the field and pass out again without entering the fixation point at all. Such compounds are only apprehended. Thus it appears that Wundt's distinction between apprehension and apperception is simply one of relative clearness and distinctness of perception. Perceptions that are vague and unclear are called apprehensions, while those which are clear, self-conscious, and voluntary are apperceptions. Consult Wundt, 'Outlines of Psychology' (1897); Stout, 'Analytical Psychology' (1896).

In law, refers to the capture or arrest of a person on a charge of having violated the criminal law. Apprehension is the term usually applied to criminal cases, as one having the power, by virtue of his office, may arrest on civil process and apprehend on a civil warrant. See Arrest.

Appren'ticeship, in law, a contract by which a person called a master, who understands some art, trade, or business, undertakes to teach the same to another person, commonly a minor, and called the apprentice, who, on his part, is bound to serve the master, during a definite period of time, in such art, trade, or business. At common law an infant may bind himself apprentice by indenture, because it is for his benefit. But this contract, on account of its

liability to abuse, has been regulated by statute in the United States, and is not binding upon the infant unless entered into by him with the consent of the parent or guardian, or by the parent or guardian for him, with his consent. The contract need not specify the particular trade to be taught, but is sufficient if it be a contract to teach such manual occupation or branch of business as shall be found best suited to the genius or capacity of the apprentice. This contract must generally be entered into by indenture or deed. The contract is to continue, if the apprentice be a male, only during minority, and if a female only until she arrives at the age of eighteen. The duties of the master are to instruct the apprentice by teaching him the knowledge of the art which he had undertaken to teach him, though he will be excused for not making a good workman if the apprentice is incapable of learning the trade, the burden of proving which is on the master. Ordinarily the indenture should contain, among other things, a stipulation that the apprentice shall be taught the general rules of arithmetic. The master must not abuse his authority, either by bad treatment or by subjecting his apprentice to menial employments unconnected with the business he has to learn; but he may correct him with moderation for negligence and misbehavior. He cannot dismiss his apprentice except by consent of all the parties to the indenture. He cannot remove the apprentice out of the State under the laws of which he was apprenticed unless such removal is provided for in the contract or may be implied in its nature; and if he do so remove him the contract ceases to be obligatory. An infant apprentice is not capable in law of consenting to his own discharge. After the apprenticeship is at an end the master cannot retain the apprentice on the ground that he has not fulfilled his contract, unless specially authorized by statute. An apprentice is bound to obey his master in all his lawful commands, take care of his property, promote his interests, endeavor to learn his trade or business, and perform all the covenants in his indenture not contrary to law. He must not leave his master's service during the term of the apprenticeship. If, without the knowledge or consent of the master, an apprentice is employed by a third person, the master is entitled to all his earnings, whether the person who employed him did or did not know that he was an apprentice. In an action for harboring or enticing away an apprentice it must be shown that the defendant had a knowledge of the apprenticeship. The enlistment of an apprentice in the military service dissolves the relation of master and servant, and the master has no claim to the bounty money or pay of the apprentice so enlisted. A master cannot delegate to another the power to chastise his apprentice, as his authority is a personal one. At common law an apprenticeship is a relation which cannot be assigned, but if under such an assignment the apprentice continue with his new master with the consent of all the parties and his own, it will be construed as a continuation of the old apprenticeship.

Appro'pria'tion, a term denoting a specific sum set apart for the legislative power for a designated purpose. In the United States no money can be drawn from the Treasury excepting by appropriations made by law (Constitution, art. 1). Under this clause it is necessary for Congress to appropriate money for the support of the Federal government and in payment of claims against it. All bills for appropriating money originate in the House of Representatives, but may be amended in the Senate. The same procedure is observed in the several States.

Appropriation of payments refers to the application of a payment made to a creditor by his debtor, to one or more of several debts. The debtor has the first right of appropriation. No precise words are required of him, his intention when made known being sufficient, but such facts must be proved as will lead a jury to infer that he did intend to make the specific appropriation claimed. An entry made by the debtor in his own book at the time of payment is an appropriation if made known to the creditor, but otherwise if not made known to him. The same rule applies to a creditor's entry communicated to his debtor. If the debtor does not apply the payment, the creditor may do so. There are, however, some restrictions upon this right. The debtor must have known and waived his right to appropriate. Hence an agent cannot always apply his principal's payment. He cannot, upon receipt of money due his principal, apply the funds to debts due himself as agent, selecting those barred by the statute of limitations. A creditor having several demands may apply the payments to a debt not secured by sureties, where other rules do not prohibit it. The court will direct the application of a payment upon the failure of both debtor and creditor to do so. Payments made on account are first to be applied to the interest due thereon at the time of payment, and if the payment exceed the amount of interest, the balance goes to extinguish the principal. 3 Sandf. Ch. N. Y. 608; 11 Paige Ch. N. Y. 619. Funds must be applied by the creditor to a judgment bearing interest, in preference to an unliquidated account. When no other rules of appropriation intervene, the law applies part-payments to debts in the order of time, discharging the oldest first. The general rule is that neither debtor nor creditor can so apply a payment as to affect the liability of sureties without their consent. Where a principal makes general payments the law presumes them, *prima facie,* to be made upon debts guaranteed by a surety rather than upon others, although circumstances and intent will control this rule, as they do other rules of appropriation. 5 Leigh, Va. 329. Payments upon continuous accounts are applied to the earliest items of account unless a different intent can be inferred. 5 Metc. Mass. 268; 23 Me. 24; 3 Sumn. C. C. 98. Where a creditor of an old firm continues his account with the new firm, payments by the latter will be applied to the old debt, *prima facie,* the preceding rule of continuous accounts guiding the appropriations. A different intent, however, clearly proved, will prevail. The appropriation cannot be changed, when once made, but by common consent, and rendering an account and bringing suit declaring in a particular way is evidence of an appropriation. 9 Paige, Ch. N. Y. 165.

Approx'ima'tion, a term in mathematics signifying a continual approach to a quantity required, when no process is known for arriving at it exactly. Although, by such an approximation, the exact value of a quantity cannot be discovered, yet in practice it may be found sufficiently correct; thus the diagonal of a square whose sides are represented by unity is $\sqrt{2}$, the exact value of which quantity cannot be obtained; but its approximate value may be substituted in the nicest calculations. This process is the basis of many calculations in pure and applied mathematics, and is of frequent use and great importance in all practical operations.

Appur'tenance, in legal phraseology anything belonging to another thing as principal, and which passes as incident to the principal thing. 10 Pet. U. S. 25; 1 Serg. & R. Pa. 169. For instance, if a house and land be conveyed, everything passes which is necessary to the full enjoyment thereof and which is in use as incident or appurtenant thereto. If a house is blown down, a new one erected there shall have the old appurtenances. 4 Coke 86. The appurtenances of a ship include whatever is on board of it for the objects of the voyage and adventure in which she is engaged, and which belong to her owner.

Aprax'ia, a term denoting a loss of power to appreciate the use and nature of common objects. Thus a patient with this affection might try to comb his hair with a tooth-brush or blacken his boots with a dinner-plate. It is a purely psychical disorder and frequently accompanies aphasia.

Apraxin, a-präks'ĭn, **Feodor Matejevitch,** a Russian admiral: b. in 1671; d. in Moscow in 1724. He may be considered as the creator of the Russian navy and was the most powerful and influential person at the court of Peter the Great, who made him chief admiral. In 1708 he defeated the Swedish general Lübecker in Ingermannland and saved the newly built city of St. Petersburg from destruction. In 1713 he took Helsingförs and Borgo and defeated the Swedish fleet. He was twice fined for embezzlement, but, being too useful to be dispensed with, Peter, in both instances, neutralized the effects of the condemnation by conferring upon him additional riches and dignities.

Apraxin, a-präks'ĭn, **Stepan Fedorovitch,** a Russian general, grandson of F. M. Apraxin (q.v.): b. in 1702; d. in 1760. He defeated the army of Frederick the Great at Gross-Jägerndorf in 1757, but, omitting to follow up his victory by proceeding to Berlin, was tried by court-martial, but died before sentence was pronounced.

Apricot, a small tree (*Prunus armeniaca*), of the natural order *Rosaceæ*, long grown for its fruit and supposed to be a native of China, whence it reached Europe by way of western Asia in the time of Alexander the Great. The fruit resembles the peach in form, color, and its downy skin, and has a large, smooth, or slightly furrowed plum-like pit. It usually ripens earlier than either the peach or the plum. The choice varieties, of which, considering the length of time that it has been in cultivation, there are comparatively few, are firmer, less juicy, but probably higher flavored than the peach. The tree is plum-like in leaf and habit and peach-like in bark. The apricot demands practically the same general management and is as hardy as the peach and succeeds in similar climates and situations.

Eastern Apricot Growing.— Though grown to some extent in the eastern United States, the apricot has not become widely popular for four principal reasons: its susceptibility to injury from late spring frosts which destroy the very early appearing blossoms; the attacks of its special enemy, the curculio (see PLUM); incomplete knowledge of suitable stocks upon which to work it so as to ensure its most perfect growth in various soils, etc.; and ignorance of its dessert qualities, probably owing to the lack of systematic exploitation by nurserymen. Best results seem to be obtained upon the deep, dry, gravelly loams suited to the apple, where such lands are situated on the leeward side of large bodies of water or elevated and facing the north. The trees are usually set 20 feet apart and cultivated like the peach, but since the fruit-bearing habit is similar to that of both the plum (on spurs) and the peach (on wood of the previous season's growth), pruning resembles most nearly that of the plum. When properly managed and grown under favorable conditions the apricot probably equals the peach in productiveness, but like other tree fruits the fruit must be systematically thinned to obtain specimens of good size and to prevent bearing in alternate years. Since the apricot is even more a dessert fruit than the peach and must be carefully grown, picked, packed, and marketed, only the most careful Eastern fruit growers attempt its extensive cultivation. The chief disease, leaf-spot, is treated under PEACH.

California Apricot Growing.— Though the apricot has been known in California for more than a century in the vicinity of the Missions, where it was grown mainly from seeds, it has become commercially important only since American occupancy, in the early years of which improved varieties were introduced from Europe. In the Old World these varieties were trained to walls and otherwise coddled; in California they require no such treatment. As a consequence the apricot has become a leading fruit of the State where in 1899 more than 40,000 acres were devoted to this crop. The world-wide demand for the fruit, fresh, dried, canned, and candied, is fostering still wider planting, and California, already the greatest apricot-growing region of the world, seems destined to be still greater. The tree is found to succeed well on the higher ground of interior valleys upon a variety of soils, but, as in the East, is susceptible in the low ground to injury by late spring frosts. For detailed account of California apricot-growing, consult Bailey 'Cyclopedia of American Horticulture,' (1900–2).

A Priori («from what goes before»), a phrase applied to a mode of reasoning by which we proceed from general principles or notions to particular cases, as opposed to *a posteriori* («from what comes after») reasoning, by which we proceed from knowledge previously acquired. Mathematical proofs are of the *a priori* kind; the conclusions of experimental science are *a posteriori*. It is also a term applied to knowledge independent of all experience.

Apsides, ăp'si-dēz (the plural of *Apse* or *Apsis*), an astronomical term designating the two points in the elliptic orbit of a planet where it is at the greatest and the least distance respectively from the body around which it revolves. The moon moving in an elliptic orbit around the earth, which is situated in one of the foci, is at what was anciently called its higher apse when in apogee, and at its lower one when in perigee. Similarly, the primary planets, including the earth and some of the comets, moving in elliptic orbits around the sun, which is situated in one of the foci, pass through their higher apse when in aphelion, and their lower one when in perihelion. It is the same with the satellites of Jupiter when they are farthest from Jupiter and nearest to it.

The line of the apsides is the line connecting the two apsides of a primary or secondary planet.

The progression of the moon's apsides is a slow movement in the position of the apsides of the moon, produced by the perturbing attraction of other heavenly bodies. It is about three degrees of angular motion, in one revolution of the moon, and in the same direction as her progression in her orbit. The apsides of the primary planets are also perturbed.

Ap'sley Strait, a narrow channel between Melville and Bathurst Islands, off the north coast of Australia. It is about 40 miles in length, with a breadth varying from 2 to 5 miles. The land is low on either side, and the shores bordered by a broad belt of impenetrable mangroves, and indented by numerous salt-water creeks, which present the appearance of rivers. Alligators of enormous size abound in the Straits, many of them measuring from 14 to 17 feet in length. A settlement was formed in 1824, on the Melville Island side of the channel, about 8 or 10 miles from its northern entrance, but subsequently abandoned.

Ap'teryx, a strange flightless bird of New Zealand, representing the *Apteryges*, a group of ratite birds nearly related to the extinct dinornis. Four or five species are known in the various islands of the New Zealand group, besides two fossil species. These curious birds, called "kiwis" by the natives, are about the size of domestic fowl and have very stout legs, wings reduced to a mere useless stump, long snipe-like beaks, and no visible tail. The plumage is colored in streaked browns and grays, and the feathers are incomplete, the disunited filaments giving them the appearance and feeling of coarse hairs. Kiwis inhabit the forested hills, going about in small flocks which during the day hide in the thickets or in cavities of the ground or rocks. They sleep during the bright part of the day rolled up into a ball, but sometimes rest for a long period in a standing position, with the point of the bill touching the ground, as though they were leaning upon it. Their feeding-time is in the dusk of early morning and at evening, and their diet consists chiefly of worms, which they search for apparently mainly by the sense of smell, and obtain by probing the ground with their long bills. The nostrils are at the tip of the beak, which is also flexible and extremely sensitive to the touch, so that a worm may be detected when it is touched, although the bill may need to be thrust its whole length into the ground. The nest is usually at the end of a round tunnel dug in soft earth by the female, and consists of a little dry fern or a few leaves. The eggs, generally two in number and incubated mainly by the male, are remarkable for their size, since they are equal to a quarter of the mother's weight. They are greenish white in color with a smooth surface. As might be expected from the size of the egg, the development of the young reaches a high degree of maturity before hatching. The Maories are very fond of the flesh of the kiwi, either roasted or boiled, and their persistent hunting had greatly decreased the number of the birds before white men reached the islands. Since that time dogs and other accompaniments of civilization have nearly exterminated these birds, which are the sole survivors of the moas. The most complete description of their habits will be found in Buller's 'Birds of New Zealand' (second edition, 1888). For anatomical details and relationships see Parker's memoirs in the 'Philosophical Transactions' for 1891 and 1892. A good summary of this information will be found in Newton's 'Dictionary of Birds' (1896). See DINORNIS; MOA.

Ap'thorp, William Foster, an American dramatic and musical critic: b. in Boston, Mass., 24 Oct. 1848. He was graduated from Harvard University in 1869 and pursued his musical studies under J. K. Paine and B. J. Lang. He taught in the New England Conservatory and College of Music to 1884, was musical critic for the 'Atlantic Monthly' 1872–6; the Boston *Sunday Courier* 1876–8; and the *Evening Traveler* 1878–80. He has been musical and dramatic critic for the Boston *Evening Transcript* since 1881, and was the critical editor of Scribner's 'Cyclopædia of Music and Musicians.' He has written 'Hector Berlioz' (1879); 'By the Way'; 'Music and Music Lovers'; 'Opera, Past and Present.'

Apule'ius, or **Appuleius, Lucius**, a satirist and philosopher of the 2d century: b. at Madaura, in Numidia; the time of his death is unknown. He was author of the celebrated satirical romance called the 'Golden Ass.' He first studied at Carthage, then renowned as a school of literature, and afterward went to Athens, where he became an ardent follower of the Platonic philosophy. Falling ill while on a journey he was hospitably received in the house of Sicineus Pontianus, a former fellow-student, whose widowed mother Apuleius married. Soon after Pontianus died, and the relatives of the rich widow publicly accused Apuleius of having used magical arts to gain her love. The speech by which he successfully defended himself, 'Apologia sive Oratio de Magia,' is still extant. The remainder of his life, which he devoted to oratory and literature, seems to have been passed at Carthage, where, as in some other cities, a statue was erected in his honor. His 'Metamorphoses,' 'Golden Ass,' a romance in eleven books, contains wit, humor, powerful satire, and much poetical merit. It is supposed to have been intended as a satire on the hypocrisy and debauchery of certain orders of priests, on the tricks of pretenders to supernatural powers, and on the prevalent vices generally. The finest part of this work

is the episode of Psyche, called by Herder the most tender and many-sided of all romances. It is sufficient to render him immortal, even if he be, as some have supposed, only the narrator, and not the inventor of the story. Apuleius was also the author of many works on philosophy and rhetoric, some of which are still extant. Cervantes, Le Sage, Boccaccio, and others are indebted to Apuleius for various episodes. See edition of his complete works, Hildebrand (1842); Van Vliet (1897–1900). An English translation by Head was published in Bohn's Classical Library in 1851.

Apu'lia, a province of southern Italy, composed of the provinces of Foggia, Bari, and Lecce; area, 8,539 square miles; pop. (1901) 1,949,425. The northern part forms the Apulian Plain, a rather barren tract on the whole, although affording extensive sheep pastures and isolated spots capable of cultivation, on which wine, olives, southern fruits, and maize are grown. The surface of the plain is not quite level, but diversified by broad undulations crossing one another at right angles. The southern portion is traversed from west to east by low ranges of hills. In the extreme northeast of this part of the province rises close to the sea the isolated mountain Gargano, which attains the height of nearly 5,000 feet. The most important river is the Ofanto (Aufidus). There are four coast-lakes of considerable size. Lake Salsi dries up in a great part in summer; and on its banks are the great salt-boiling works of Barletta. There is a considerable trade in grain, oil, salt, southern fruits, cattle, wool, etc. Apulia was in ancient times inhabited by several peoples, such as the Apuli, Messapii, and Daunii. It was subdued by the Romans in 317 B.C.

Apure, ä'poo-rā', a river in Venezuela, formed by the junction of several streams issuing from the Sierra de Merida. After an eastern course of about 300 miles it falls into the Orinoco at Capuchino. It is navigable throughout almost its entire course.

Apurimac, ä-poo'rē-mäk', the name of a department of Peru, embracing a territory of 8,187 square miles and lying between the departments of Cuzco and Ayacucho. Its capital is Abancay. Pop. (estimated, 1902) 178,000.

Apurimac, a Peruvian river in South America, the outlet of a lake in the Andes of Peru, in the province of Arequipa, not far from Caylloma. It is probably the tributary of the Amazon rising nearest the Pacific Ocean. It flows through a mountainous country in a northerly direction, and, joining the Yucay or Vilcamayu at lat. 9° 15′ S.; lon. 72° 30′ W., forms the Ucayale, one of the principal tributaries of the Amazon. Its entire extent is between 500 and 600 miles.

A'pus, a name designating a fresh-water phyllopod crustacean, remarkable for having 47 body-segments, 20 being the normal number in *Crustacea*. It also has 60 pairs of limbs, certain segments bearing as many as six pairs of legs, the normal number in all arthropods being no more than a single pair to a segment. The body is protected by a large carapace resembling that of the king-crab (q.v.) in that it is adapted for burrowing in soft mud at the bottom of lakes or pools. Apus is locally distributed over western North America, Asia, and Australia. One form (*Lepidurus glacialis*) lives in pools in the Arctic regions. It undergoes a complete metamorphosis, its larva being a "Nauplius" (q.v.). The family (*Apodidæ*) appears to be of high antiquity, since the impression of an obscure crustacean (*Protocaris*), generally referred to it, has been detected in the lower Cambrian rocks of Vermont. See Packard, 'Monograph of North American Phyllopod Crustacea' (1883); Bernard, 'The Apodidæ' (1892). See PHYLLOPODA.

A'qua (Latin, water), a word used by the alchemists and early chemists for solutions or other fluid preparations in which the menstruum is water. *Aqua ammoniæ* ("ammonia water") is an aqueous solution of ammonia gas (NH_3). *Aqua fortis* ("strong water") is nitric acid. *Aqua regia* ("royal water") is a mixture of nitric and hydrochloric acids, the name (bestowed by Basil Valentine) referring to its power of dissolving gold and other so-called noble metals. *Aqua vitæ* ("water of life"), so-called by Avicenna, is common grain alcohol. The word "aqua" is still in general use in pharmacy for designating aqueous solutions or infusions.

A'quæ So'lis, the ancient Roman name of the modern English city of Bath. It was famed for the splendor of its buildings and its many springs, and the remains of several Roman baths have been discovered here.

Aquamarine, ă-kwa-ma-rēn' (from the Latin *aqua marina*, "sea water"), a bluish-green variety of beryl (q.v.) esteemed as a gem. Siberia and Brazil have long been celebrated localities, while magnificent gem material has lately been mined in North Carolina.

Aqua'rians, a name applied to Christian ascetics in the primitive Church, who consecrated water instead of wine for the celebration of the Lord's Supper — either for the sake of abstinence, or because they thought it unlawful to drink wine.

Aqua'rium (Latin, a watering-place for cattle, from *aqua*, water), a term applied to a tank or smaller receptacle filled with water and stocked with aquatic animals and plants for study, or, in the smaller examples, for mere beauty and interest. To maintain natural conditions, both plants and animals must be present — the plants to give off oxygen for the animals, as well as to furnish food for many of them, and the animals to supply carbonic acid to the plants. Unless there is some arrangement for constant or frequent renewal of the water, it should often be aërated. Dipping it up and pouring it in again from a height will do this, if there is no less primitive way. The aquarium is provided with sea water or fresh water according as marine or fresh-water life is to be kept; when it is difficult to secure sea water for a marine aquarium, one may prepare a substitute by dissolving common salt, epsom salts, and certain other salts in the proper proportions in fresh water; but, when thus artificially prepared, salt water is not fit for the reception of animals until certain plants, particularly species of *Ulva*, a genus of green algæ, have lived in it. With aëration and the removal of any dead animal or rotting plant, the water may be kept in good condition for a

1 and 2. BALANCED AQUARIA

3. MAIN HALL OF NEW YORK AQUARIUM

long time if supplied with a number of mollusks for the consumption of the too abundant growth of the algæ and of their spores, which, otherwise, soon fill and discolor the water. When aquaria are placed in insufficient light, noxious fungi sometimes develop in them, doing injury to the other inmates. Fresh-water fishes in particular are subject to fungous parasites which attack their eyes, gills, or any chance wound. They may frequently be cured by a bath in a strong solution of common salt, which affects them severely, but from which they recover if washed in an abundant stream of fresh water. The large public aquaria which exist in many cities are a great aid to students and a constant source of entertainment to the people. In America the aquarium of the United States Fish Commission at Washington and the New York city Aquarium are most important. The latter is under the control of the Department of Parks and was established in 1897 in old Fort Clinton (known for many years as Castle Garden) on the Battery. It is entirely free and has a daily average of 4,000 visitors; both marine and fresh-water animals are exhibited. In the floor are seven large pools, and the wall tanks number nearly 100. All the arrangements are the best which experience has yet suggested, and opportunities for special study of ichthyology and the natural history of marine animals are afforded. In Europe the aquarium at Brighton, England, and particularly that connected with the Marine Laboratory at Naples, are of the greatest interest and importance. The most recent American work on the construction and management of an aquarium is G. E. Smith's ‹The Home Aquarium.› For information upon the sea-animals suitable for keeping in a marine aquarium consult Verrill, ‹Invertebrates of Vineyard Sound,› in the annual reports of the United States Fish Commission for 1871–2.

Ernest Ingersoll,
Editorial Staff, ‹Encyclopedia Americana.›

Aqua'rius (the water-bearer), in astronomy, (1) the 11th of the twelve ancient zodiacal constellations, now generally called signs of the Zodiac. (2) A division of the ecliptic — that between 300° and 330° of longitude, which, on account of the precession of the equinoxes, has gradually advanced from the constellation Aquarius, once within those limits. The sun enters this part of his course about the 21st of January, at which time there are generally copious rains in Italy, whence the name Aquarius = the water-bearer or water-man. (Herschel's ‹Astronomy,› §§ 380, 381.) It is marked thus ♒.

Aquat'ic Animals, a term denoting animals living constantly in water, and also those which swim on its surface or plunge beneath it for food. While the great majority of crustaceans are aquatic, a few, such as the wood-louse and the land crab, are modified for life ashore. Among mollusks there is occurrence of both aquatic and terrestrial habit, while numerous forms illustrate the transition from the former to the latter. The ascidians are exclusively marine. Some fishes have a limited power of life out of the water, the double-breathing *Dipnoi* being in this connection especially instructive. Among many amphibians the transition from water to *terra firma* is seen in the individual life-history, when the fish-like gilled tadpole becomes the lunged gill-less frog; while in a few exceptional cases, such as the black salamander of the Alps, the life is terrestrial from first to last, and even the young dispense with their preliminary swim as tadpoles, although a brief recapitulation of their aquatic life is still represented by a gilled stage within the body of the parent. The instance of the gilled axolotl becoming, in the absence of sufficient water, the gill-less amblystoma, forcibly illustrates the importance of the medium as a factor in evolution. Among reptiles there are numerous aquatic forms,— chelonians, lizards, snakes, and crocodiles,— though the absence of any gill respiration marks the progressive general adaptation to terrestrial life. While an emphatically terrestrial amphibian like the tree-frog seeks a watery hole for the rearing of the young gill-breathing tadpoles, the habit is reversed in such reptiles as the sea turtle, which, having returned to the more primitive aquatic home, yet revisits the land for egg-laying purposes. The cradle of the young in both cases indicates the ancestral habit of the parent. Among the emphatically aërial birds there are cases, like that of the penguin, where the structure has become adapted to an almost exclusively aquatic life. Among mammals, the sea-cow, the seal, and the whale are familiar illustrations of very different types which have returned to the primeval watery home and aquatic habit, with consequent change of structure.

It is important to note the general fact that, in the water, animals are subjected to influences somewhat different in detail from those which mold their congeners ashore. Even contact with a different medium, varying in composition, in currents, in pressure, in contained food and oxygen, and the like, obviously involves a great diversity in structure. Modes of motion, from the swimming-bell of a medusoid contracting and expanding in the tide, to that of the lowest vertebrates as illustrated in the pelagic tunicates, or from the paddling of worm and crustacean to that of fish and frog, duck and seal, are at once familiar adaptations to, and necessary results of aquatic life. Similarly the smooth and frequently fish-like form, especially of actively locomotive water-animals, is a very noticeable adaptive result of the conditions of life. In the more thoroughly aquatic animals, which have remained in the primitive environment, and not merely returned to it, the blood is usually purified by being spread out on feathery gills which catch the oxygen dissolved in the water; while in terrestrial forms which have betaken themselves to an aquatic life, the ordinary direct «air-breathing» is still accomplished at the surface of the water, or in some isolated cases of insects and spiders, by means of the air entangled in their hairs, or even conveyed into their submerged homes. The aquatic respiration of some larval insects, the power that some crustaceans and fishes have of keeping up a respiration on land with a minimum of water about their gills, and, above all, the cases of the double-breathing fishes or *Dipnoi*, and of amphibians already referred to, are especially instructive in regard to the problem of transition from one medium to the other. The genuinely aquatic animals are known to have a body temperature not much higher than that

of the surrounding medium, and often survive even the freezing of the water; while in the higher warm-blooded vertebrates which have returned to an aquatic habit, various modifications, such as thick fur and plumage, waterproof varnish, formation of blubber, serve as protections against the cold.

Aquat'ic Plants, a term applied to plants growing in or belonging to water. All vegetation was probably aquatic at first, certain plants becoming terrestrial by degrees. Numerous plants are, moreover, in the strict sense of the word aquatic, having never acquired or having lost all direct connection with the soil. The algæ are mainly aquatic, though many occur in damp situations on land, or on other organisms, while others remain for long periods quiescent in comparative dryness. Many algæ are absolutely isolated in the water, while others are more or less intimately fixed to some solid substratum. Fungi are very seldom found in water, and lichens are also emphatically terrestrial. Some liverworts, again, occur floating in lakes, but the majority grow in very damp places and mark the transition to the generally terrestrial life of mosses and ferns. Some rhizocarps, such as *Salvinia*, are aquatic, with leaves rising to the surface, while others are land or marsh plants, like the higher horse-tails and club-mosses.

Among the flowering plants, or phanerogams, a return to aquatic life is exhibited by numerous though exceptional cases, while a very large number grow in moist situations and have a semi-aquatic habit. The simple monocotyledons, known as *Helobiæ*, or marsh lilies, are more or less strictly water-plants. The arrow-head (*Sagittaria*), and other *Alismaceæ;* the *Butomis* of the marshes; *Hydrocharis*, with floating kidney-shaped leaves; the water-soldier (*Stratiotes*), with narrow submerged leaves; and the Canadian pond-weed (*Anacharis*), which, though entirely flowerless in Europe, threatens to choke some canals and lakes, are familiar representatives. The little duck-weed (*Lemna*), floating on the surface of stagnant pools, is one of the commonest aquatic monocotyledons; and the pond-weeds (*Potameæ*) found in both fresh and salt water: the lattice-plant (*Ouvirandra*), with its skeleton leaves; various estuarine and fresh-water naiadaceous plants,— for example, *Zostera* and *Naias*, are also common instances, while those growing in marshy ground are far too numerous to mention. Among dicotyledons the white water-buttercup (*Ranunculus aquatilis*), with its slightly divided floating and much dissected submerged leaves; the yellow and white water-lilies (*Nymphæa*); the sacred lotus flower of the Ganges and Nile (*Nelumbium*); the gigantic *Victoria regia* of tropical South America; and the insectivorous bladderwort or *Utricularia*, are among the more familiar aquatic forms.

A'quatin'ta, the name given to a method of engraving or etching upon copper or steel, invented by Leprince in 1760. The outline of the subject having been etched and bit, the plate is thoroughly cleansed, and a thin layer of etching ground is again spread over it. When dry, the parts of the subject to be aquatinted are carefully painted over with a mixture of olive oil, turpentine, and lamp-black; this fluid, laid on with a hair pencil, quickly dissolves the parts of the ground it covers, which are then wiped off. The plate is next dusted all over with a finely-powdered white resin or mastic, and when equally distributed the superfluous resin is shaken off, and the plate gently heated over a charcoal fire till the resin dissolves and adheres to the bare metal. In dissolving, the grains of the resin run into small granules, leaving minute and peculiarly shaped portions of the metal open to the action of the aquafortis, a weak solution of which is then poured over the plate. When corroded to the proper strength the subject has acquired what may be termed the first wash of color. The plate is then cleaned, re-covered with ground, and treated as before, for the second tint. The process is repeated until all the deeper tones of shading are completed. These operations are sometimes reversed, the darkest shades being first bit in, and the lighter ones added by degrees.

Aq'ueduct, a term denoting an artificial channel or conduit for the conveyance of water from one place to another; more particularly applied to great architectural structures for conveying water from distant sources for the supply of large cities, until the recent development of water-ways on a large scale for irrigation, mining, and power has brought this term into more general use. Works for supplying communities with water must have been constructed at a very early period. In China there are said to be aqueducts dating back to prehistoric times. In Persia and Assyria there are structures whose remains indicate that they were used for aqueducts, but their history is not clear. Recent excavations at Jerusalem have laid bare wells and channels cut in the solid rock, and indicate that the water supply of the city was brought from the neighborhood of Bethlehem and Hebron. These channels seem to have been composed of earthen pipes incased in stones and covered with rough rocks cemented together. It is supposed that King Solomon built aqueducts; others are ascribed to Rameses the Great, in Egypt, and to Semiramis in Assyria. There are also early remains at Palmyra in the wilderness. In the island of Samos have recently been discovered remains of a tunnel nearly a mile long and containing water-pipes about nine inches in diameter. These may have been built in 687 B.C. by Eupalinos of Megara. Water was brought to Athens from Mount Hymettos and Mount Pentelikon; Thebes, Megara, Pharsalos, and other places also had aqueducts. In Patara, a city of Lycia, in Asia Minor, there is a very ancient aqueduct consisting of an embankment of rough stone 250 feet high and 200 feet long, with an archway at the centre of the valley, allowing the stream to pass through it underneath. The channels for the water consist of cubical stone blocks about a yard in dimension, with a hole 13 inches in diameter, the blocks being closely connected and cemented together.

Roman Aqueducts.— While the Greeks developed underground water-ways and canals, and followed simple methods, the Romans under their great engineers produced massive structures for carrying water at a high level across valleys and plains. At first Rome was satisfied with water from the Tiber, from wells, and the abundant springs which gushed forth within its precincts. Four hundred and forty-two

years preceded the first aqueduct, which was the joint work of Appius Claudius Cæcus and Caius Plautius Venox, censors in 312 B.C. Appius Claudius built the conduit, Venox discovered the springs. The entire length of the aqueduct was 16,445 metres, or about 10 miles, and it furnished 115,303 cubic metres a day. The second aqueduct was begun in 272 B.C. by Manius Curius Dentatus, and was finished three years later. Its length was 63,704 metres, or about 45 miles, and it furnished 277,866 cubic metres a day; it was not used for drinking, but for irrigating gardens and flushing drains. In 144 B.C. the Senate determined to repair the two old aqueducts and build a new one. This work was begun by Quintus Marcius Rex. The Marcian aqueduct brought the water from 36 miles away in the territory of Arsoli, and fed water to the highest platform of the capitol. It was restored in 33 B.C., and Augustine doubled the supply of water in 5 B.C. In 79 A.D. Titus repaired it; in 196 Septimius Severus brought in a new supply for his baths; in 212–3 Caracalla cleaned out the springs, added a new one, and restored the aqueduct, building a branch four miles in length for his baths; in 305–6 Diocletian performed the same service. The viaducts and bridges by which it crossed the highlands are magnificent. There are seven bridges, some of them carrying four aqueducts. The Marcian reaches Rome at the Porta Maggiore, where no less than 10 water supplies met. It was restored as recently as 1869 and brings a water supply from the Sabine Mountains. The noble arches which stretch across the Campagna for some six miles on the road to Frascati are a portion of this aqueduct. The Aqua Tepula and Aqua Julia, combined by Agrippa in 33 B.C., had a length, the one of 17,745 metres, or 10 miles, the other of 22,853 metres, or about 12 miles, and a combined flow of 104,300 cubic metres a day. Of the nine aqueducts which brought water to ancient Rome, three still supply the modern city, namely, the Aqua Virgo, now Acqua Vergine, finished by Agrippa, 27 B.C., and restored by Pope Nicholas V. in 1453; the Aqua Trajana, now Acqua Paolo; and the Aqua Marcia.

The Romans also constructed important aqueducts for the cities throughout their empire. In 120 A.D. the emperor Hadrian constructed the aqueduct of Saghuan, which supplied Carthage with water, bringing it by arched bridges of stone or concrete about 60 miles. This aqueduct still supplies Tunis with water. Hannibal is said to have erected an aqueduct at Martorell, in Spain. The aqueduct of Alcantara, also in Spain, stretches over the Tajo, and is 125 feet high, with a span of over 100 feet. There are other Spanish aqueducts at Chelves, at Merida, over the Albareges, and at Segovia. That at Segovia was originally built by the Romans, has in some parts two tiers of arcades 100 feet high, is 2,921 feet in length, and is one of the most admired works of antiquity. The one at Evora, in Portugal, is still in excellent condition. One of the finest aqueducts in Europe is the Pont du Gard, built in the 3d or 4th century, or possibly by Agrippa, 19 B.C., at Nimes, in southern France. It is still in a good state of preservation. It is higher than any about Rome itself, being fully 180 feet in height, and the length of its highest arcade is 873 feet. It is composed of three tiers of arches, each less wide than the one below, and is admirably constructed of large stones, with no cement used except for the canal on the top. There is an aqueduct at Paris, built by Julian in 360 A. D., also a very important aqueduct at Constantinople, built by Hadrian and restored by Theodosius. Since 1885 the water has been furnished the city by an aqueduct built by a French company, taking the supply from Lake Derkos, whence the water is pumped 358 feet into a reservoir. The ruins of an aqueduct exist at Mayence, and those of another near Metz, Germany. The aqueduct at Spoleto, Italy, is attributed by some to the East Gothic king Theodoric, in 500 A. D., and by others to Theodelapius, the third Duke of Spoleto, 604 A.D. It is built of brick and rests between two steep cliffs on 10 arches, and is 290 feet in height and 231 yards in length. The ground plan is apparently Roman, while the pointed arches indicate a restoration in the 14th century. Many important aqueducts are found in more recent times. One of the most remarkable is that constructed by Louis XIV., in 1684, to convey the waters of the Eure from Point Gouin to Versailles. Troops to the number of 40,000 were employed in this great undertaking. Thousands of these men died during the progress of the work, which was interrupted during the war of 1688 and never resumed. The bridge at Maintenon, forming part of this aqueduct, even in its incomplete state is, in point of magnitude, the grandest structure of the kind in the world. The remains consist of 47 arches, each 42 feet wide and 83 feet high. The piers are 25 feet 6 inches thick.

The first important aqueduct in England was built in 1613, to conduct the waters of the New River to London, over a distance of 20 miles. Wooden aqueducts were first used, but were replaced by embankments. Very large works were constructed during several years, ending in 1877, to bring water from Longdendale, between Sheffield and Manchester, to the latter city. In this instance the aqueducts consist for the most part of tunnel and covered conduit, but for eight miles the water is conveyed in large cast-iron pipes laid along or under the public roads. Before the Longdendale works were finished the question of a greater supply had to be considered. This led to the adoption of the scheme for bringing water from Lake Thirlmere in Cumberland to Manchester. The length of the line is nearly 100 miles, and the works were carried out in 1885–94. A tunnel, about three miles in length and 270 feet below the surface, forms the first part of the aqueduct. There are 13¾ miles of tunnels, 38 miles of shallow tunnels cut from the surface, and 44½ miles of siphon pipes of 40 inches diameter. The aqueduct passes under Dunmail Raise, north of Grasmere, Ambleside, Windermere, and Kendal, to the east of Lancaster and Preston, across the Rivers Lune and Ribble, past Chorley, and west of Bolton. The ultimate supply is 50,000,000 gallons daily; the cost, $21,500,000. In Scotland, the Loch Katrine aqueduct supplies Glasgow with water coming from a distance of 26 miles. An aqueduct was built in 1738, conducting water for a distance of about nine miles into the city of Lisbon. For a part of the way it is underground, but near the city

is carried over a deep valley for a distance of 2,400 feet, on several arches, the largest of which has a span of 115 feet, and is 250 feet high. The aqueduct of Caserta, in Italy, was built in 1573 by Vanvitelli, for the purpose of supplying the gardens of Caserta with water from Monte Taburno, a distance of 25 miles. It now conducts the water to Naples and crosses 20 valleys; the last 15 miles the water is carried in iron pipes. The Canal de Marseilles, in France, is 57 miles in length. It conveys water from the River Burance to Marseilles, and is a magnificent specimen of engineering. It was finished in 1847. At Roquefavour it crosses a valley on a bridge, the length of which is 1,290 feet. The Vienna aqueduct, nearly 60 miles long, was finished in 1873. At several places in its course there are extensive aqueduct bridges, built either entirely of stone or of stone and brick. This aqueduct supplies 20,000,000 gallons of water per day. In America are a number of important aqueducts. For 125 years the city of Otumba, in Mexico, received its supply of water through the aqueduct of Zempoala, a canal 27 miles long, which, though said to be in almost perfect condition, has not been used since 1700. New York is supplied with water from the Croton River, which falls into the Hudson above Sing Sing. The first aqueduct, which was constructed between the years 1837 and 1842, at a cost of $12,500,000, is 38 miles long with a general declivity of 13¼ inches to the mile, and is eight feet five inches in height, and seven feet eight inches in greatest breadth. Stone, brick, and cement are used for the encasing masonry. The conduit, where it crosses the Harlem River, was carried in iron pipes over a splendid bridge 150 feet above the river. Although an important and well-executed work this aqueduct was soon found to be inadequate for the greater city, and a new and larger reservoir and aqueduct were put into service in 1890. The water-way is 33 miles long, 29 of which lies in a tunnel through rock, where a horseshoe-shaped brick, or stone and cement conduit 13½ feet high is constructed. At the Harlem River this water is carried through an inverted siphon 300 feet beneath the river. The siphon has been used also to carry water under the Danube at Nansdorf, Germany. It replaces the old Roman arched water-way and is possible since the system of building ceiled conduits has come into general use. The first aqueduct for supplying Boston with water was built in 1846–8, 30 years later an aqueduct was built to carry water from the Sudbury River to Boston. This line crosses the Charles River on a large stone arch known as Echo Bridge, and has a fine bridge also in the Waban valley. As the city demanded a still greater supply an immense reservoir was projected to retain 65,000,000,000 gallons of water in the Nashua valley near Clinton, Mass., from which the water is to be conducted to the Metropolitan district of Boston. With this it is said the city will have a supply of 400,000,000 gallons of water daily. The cities on the Great Lakes require a peculiar system for supplying water. Tunnels are built out under the lakes (four miles at Chicago) to secure unpolluted water, and though of simple masonry, are difficult to construct. The great canals, such as the Suez, the projected Panama Canal, and the Chicago Drainage Canal are really aqueducts. The latter was completed in 1899 at a cost of $33,000,000. It carries 300,000 gallons of water per minute from the Chicago River and Lake Michigan to the Illinois River. A unique aqueduct was built in Pittsburg, Pa., in 1845. A canal was suspended from two cables across seven spans of 160 feet each. The demands of irrigation have required the construction of many aqueducts. In the western United States there are thousands of miles of canals, with dams, tunnels, and costly bridges. In British India, where the rainfall is uncertain, the government has constructed the Ganges Canal, which takes the most of the water from that river and distributes it over a vast area. In the development of water-power some large aqueducts have been constructed. At Niagara Falls a canal leading from the falls has been cut in solid rock. In the mining regions, water-ways and flumes are constructed of considerable proportion, but generally of a very temporary character and hardly to be considered as aqueducts. See CANALS; DAMS; FLUMES; IRRIGATION; WATER-POWER; WATER-WORKS.

A'queous Hu'mor, the designation of the transparent lymphatic fluid in the anterior chamber of the eye, or that portion of the interior of the eye in front of the crystalline lens. In its chemical composition aqueous humor closely resembles the cerebro-spinal fluid. It is a clear alkaline liquid, specific gravity, 1003–1009, and contains about one per cent of solids, one tenth of which are proteids. These are fibrinogen, serum albumin, and serum globulin. Traces of urea and sarcolactic acid are present. The secretion of aqueous humor is rapid. It is supposed that this fluid is derived from the posterior surface of the iris and the ciliary body. See EYE.

A'queous Rocks, the title of a petrographic division including all rocks that have been deposited under water. It is the most important class of the sedimentary series, and comprises such common and widely distributed strata as sandstones, conglomerates, shales, and limestones, and many valuable products, as gypsum, salt, and coal. According to their manner of origin the aqueous rocks may be subdivided into (1) mechanical deposits, (2) chemical precipitates. (3) organic accumulations. The mechanical deposits have been derived from the disintegration of pre-existing strata and the transportation of the materials by rivers, tides, and currents. They are being formed at the present time beneath the ocean and in rivers and lakes. Sandstone, conglomerate, clay, shale, and marl are the most important members of this subdivision. The chemical precipitates owe their origin to the deposition of materials from solution either as a result of evaporation or by the action of precipitating agencies. Oölitic limestone, gypsum, rock salt, siliceous sinter, and many iron ores are included in this subdivision. The organic accumulations have been formed from materials once belonging to living organisms. Limestones and chalk represent the comminuted and compacted remains of shells, corals, crinoids, foraminifera, etc., while certain organisms secrete silica, and their casts have accumulated in the form of infusorial earth, chert, and fluid. Peat and the different varieties of

coal are deposits of vegetable matter which has been more or less completely transformed into carbon under the influence of pressure and sometimes also of heat.

Aquifoliaceæ, ă'quĭ-fō-lĭ-ā'cē-ē, the designation of a natural order of plants, composed of shrubs with alternate or opposite persistent leaves, of thick texture and smooth surface, with a toothed margin, the teeth being sometimes spinous. The flowers are solitary, or variously grouped in the axillæ of the leaves. The fruit is always fleshy, containing from two to six indehiscent woody or fibrous nucules or minute nuts enclosing single seeds. The American holly, *Ilex opaca*, has foliage less glossy, and berries less red than its European relative, *Ilex aquifolium*. Both are important commercially, being mostly used for decorative purposes. The genera are *Ilex, Cassine, Myginda.* The leaves of a species of *Ilex* afford the famous Paraguay tea. But one member of this order is found in Europe, the common holly (*I. aquifolium*). The other members are found sparingly scattered over different parts of the world, especially the West Indies, South America, and the Cape of Good Hope. The Latin *Ilex*, the holm-oak (*Quercus ilex*), belongs to a different natural order from the holly, and to the same order as the oak (*Corylaceæ*).

Aquila, ä'kwe-la, one of the early Christians associated with Saint Paul, was of Jewish origin and a native of Pontus. In the year 52, he with other Jews, was expelled from Rome by an edict of Claudius. He and his wife Priscilla went to Corinth, where they first became acquainted with Saint Paul. The apostle shared their lodgings, at the same time assisting them at their trade of weaving tent cloth. He was indebted to them for many acts of kindness and none of the Christians who aided him ever received such warm praise from his pen. See Epistle to the Romans xvi. 3. There are many references to Aquila in the New Testament: Acts xviii. 1–3, and 26–28; 1 Corinthians xvi. 19; 2 Timothy iv. 19. Nothing definite is known about the death of Aquila. Though he led a poverty-stricken life in Corinth and Ephesus, better days came to him; for in the year 58 we again find him in Rome, where he and Priscilla kept a house on the Aventine, large enough to be used as a sanctuary by the Christians of Rome, to whom it was always open. Consult: Fouard's 'Saint Paul and His Missions' (Chap. vii.) and 'Saint Peter and the First Years of Christianity' (Chap. xviii).

REV. JAMES HIGGINS, D.D.,
Long Island City, N. Y.

Aq'uila, Johann Kaspar, a celebrated German Protestant theologian: b. in Augsburg in 1488; d. 12 Nov. 1560. After studying several years in Italy he was appointed pastor of Jenga, a village near Augsburg. Here he embraced the doctrines of Luther; but his boldness and zeal in the cause of reformed faith led the bishop of Augsburg to order his arrest. Aquila passed the winter of 1519–20 in the prison of Dillingen, and from Dillingen he went to Wittenberg, where he became personally acquainted with Luther. He was subsequently appointed professor of Hebrew at Wittenberg, where he rendered valuable assistance to his colleague Luther in his translation of the Old Testament. In 1527 he became pastor, and the following year Protestant bishop at Saalfeld; but his vehement opposition to the *Interim* of Charles V. in 1548 obliged him to flee. He was appointed to the deanery of Schmalkalden in 1550, and restored two years after to his office at Saalfeld, where, without further molestation, he continued to discharge his duties till his death.

Aq'uila, Ponticus, a native of Pontus, who flourished about 130 A.D., and is remembered for his exceedingly close and accurate translation of the Hebrew Scriptures into Greek. See Burkitt, 'Fragments of the Book of Kings, According to the Translation of Aquila' (1897).

Aquileja, ä'kwe-lā'ja, **Aquileia**, or **Aglar**, a town of Austria, 22 miles northwest of Trieste. Before the fall of the Roman empire it was the great emporium of trade between the north and south of Europe, and was often called the "Second Rome." Cæsar Augustus frequently resided here, and several councils of the Church, the first in 381, were held at Aquileja. In the 6th century, the title of patriarch was taken by the bishops of Aquileja, who assumed second rank to the Pope. The town was destroyed by Attila in 452, when the inhabitants numbered 100,000. It is now a small fishing village containing a number of interesting remains of its ancient splendor, and often rewarding the researchers of the antiquary with relics of value. Pop. about 2,000.

Aqui'nas, Thomas, a celebrated scholastic theologian, related by birth to several of the royal families of Europe: b. near Aquino in 1227; d. at Fossanora 7 March 1274. He studied at the Benedictine monastery of Monte Casino and the University of Naples. About the age of 17 he entered a convent of Dominicans, much against the wishes of his family. Partly to evade the endeavors of his family to recover him, and partly on account of the extraordinary aptitude he displayed for theological studies, his superiors sent him to Cologne to hear the lectures of the famous Albertus Magnus. He was so remarkable for taciturnity, and the assiduity and apparent stolidity with which he pursued his studies, that he was known among his fellow-students as "the great dumb ox of Sicily." His teacher, however, discerned his abilities, and is said to have foretold that "this ox would one day fill the world with his bellowings." In 1245 he visited Paris in company with Albertus. Becoming involved in the dispute between the University and the Begging Friars as to the liberty of teaching, he advocated the rights claimed by the latter with great energy, and, being called upon to defend his side in this controversy before the Pope, did so with complete success. In 1248 he returned with Albertus to Cologne, but revisited Paris in 1257, when he received the degree of doctor from the Sorbonne and began to lecture on theology, rapidly acquiring the highest reputation. The remainder of the life of Aquinas was one of the most varied activity. He was almost constantly engaged in lecturing and preaching, and was often sent on distant journeys in the service of his order. In 1263 he is found at the Chapter of the Dominicans in London. In 1268 he was in Italy, lecturing in Rome, Bologna, and elsewhere. In 1271 he was again in Paris lecturing to the students: in 1272 professor at Naples. In 1263 he had been offered the archbishopric of Naples by Clement IV., but refused the offer. A general council being summoned at Lyons in 1274 for the pur-

pose of uniting the Greek and Latin Churches, Aquinas was called thither to present the council with a book which he had written on the subject, but died on the way. The honors paid to his memory were prodigious: besides the title of Angelic Doctor, bestowed on him after the fashion of the times, he was called the Angel of the Schools, the Eagle of Divines, and the Fifth Doctor of the Church; in 1286 he was made by the Dominicans the doctor of their order (*doctor ordinis*); at the request of the Dominicans he was, in 1323, canonized by John XXII., his tomb supplying the necessary testimony of miracles; and 1567 was declared by Pius V. the "Fifth Doctor of the Church." The numerous works of Aquinas are all written in Latin. The most important of them is the 'Summa Theologiæ,' which, although only professing to treat of theology, is in reality designed to form a complete and systematic summary of the knowledge of the time. All the minor works of Aquinas may be looked upon as preparatory to this great one. These are 'A Commentary on the Four Books of Sentences of Peter Lombard'; 'Quodlibeta Disputata et Quæstiones Disputatæ'; the 'Catena Aurea,' or Golden Chain, in form of a commentary on the four Gospels, but in substance an exhaustive exposition of the cardinal doctrines in theology of the greatest fathers of the Church; and commentaries upon Isaiah and Jeremiah, the Epistles of St. John the Divine, and the Psalms, as well as upon Aristotle. His works were published in Rome in 1570–1 in 17 volumes, but his 'Summa Theologiæ' has passed separately through various editions. The resemblance in thinking and writing between Augustin and Aquinas is so marked, that it has been fancifully said that the soul of the one had passed into the body of the other. The disciples of Aquinas are called after him Thomists. See Werner, 'Der Heilige Thomas' (1858); Gibelli, 'Vita de S. Tomaso' (1862); Vaughan, 'St. Thomas of Aquino, his Life and Labours' (1872); Cavanagh (1890).

Aquinas, Saint Thomas, Philosophy of. The philosophy of Saint Thomas Aquinas is the culmination of the philosophic efforts of the Christian schools of the Middle Ages. These schools, dating from their foundation in the reign of Charlemagne, set up a tradition of Aristotelian commentary and of independent speculative activity which, until the middle of the 12th century, were almost entirely circumscribed by the limits of dialectic, or logic. After the middle of the 12th century the physical and metaphysical works of Aristotle (q.v.) became known in the Christian schools of Europe, and with them were introduced Arabian commentaries which interpreted the text of Aristotle in a sense contrary to Christian theism. At the beginning of the 13th century a number of Christian teachers, especially Alexander of Hales and, later, Albert the Great, undertook the task of expounding the theistic and spiritualistic philosophy of the Christian schools on the basis of Aristotle's physical and metaphysical doctrines, rejecting from the current Aristotelian teaching whatever they considered to be due to the influence of the Arabian commentators. These teachers prepared the way for Saint Thomas Aquinas (1225–74), whose chief merit is, not that he created a new method or contributed a new system of thought, but that he gave to the work of his predecessors and contemporaries a more compact synthesis and expounded this synthetic system with a simplicity and lucidity rarely to be met with in systems which like his carry complexity to a high degree of organic unity. Saint Thomas' most important works are the 'Summa contra Gentiles' and the 'Summa Theologica.' The former, begun at Paris about the year 1257 and completed some time between the years 1261 and 1264, was undertaken at the request of Saint Raymond of Pennafort for the purpose of defending the truths of Christianity against the Arabian pantheists and their followers. It is, therefore, apologetic rather than constructive in method and contents. The 'Summa Theologica' was commenced at Bologna in 1271, and was never completed. Unlike the 'Summa contra Gentiles,' it is constructive in aim and method. It is Saint Thomas' greatest work, his last and most important contribution to Christian theology and philosophy; for, although the work is entitled 'Summa Theologica' and is, in fact, a compendious treatise on all the questions of Catholic theology, it is also a summary of philosophy. It begins with the question of the existence of God, treats of the attributes of God, traces the origin of things from God and the return of man to God through Christ. It deals, therefore, with the creation and government of the universe, with the origin and nature of man, with human destiny, with virtues, vices, and laws — with all the great problems of speculative and practical philosophy. It contains the maturer views of its author, so that whenever discrepancies occur between the doctrines of the *Summa* and the views expressed in his earlier works, the *Summa* is to be taken as the key to the mind of the master.

The method used by Saint Thomas in all his constructive works is a developed and perfected form of the dialectic method which we find anticipated in a short treatise by Gerbert (Pope Sylvester II., died 1003) and of which the first definite example is the *Sic et Non* of Abelard (died 1142). In this treatise Abelard presents in contrast the affirmative (*Sic*) and the negative (*Non*) opinions of patristic writers in reference to each successive problem of Catholic theology, without, however, furnishing principles by which the discrepancies, real or apparent, are explained. This was, as far as we know, first done by Alexander of Hales (died 1245), whose method was to set forth the arguments against his thesis, then the arguments for the thesis, and finally to answer the objections. Saint Thomas practically adopted the method as he found it in use in the schools of his day, giving to each article discussed the recognized tripartite division *videtur quod non* (introducing objections), *sed contra* (introducing the argument for his thesis), and *respondetur ad primum,* etc. (answers to objections). Underlying this somewhat formal method was the principle which the schoolmen derived from Aristotle, that it is only by the dialectic discussion of the affirmative and negative sides of a question the truth is to be discovered and defined. In other words, the faculty of the mind on which philosophy chiefly relies is not intuition but ratiocination.

In describing the content of Saint Thomas' philosophy one must advert, in the first place,

to the Aristotelian mold in which all his philosophical doctrines are cast. For him Aristotle is the philosopher. On the questions of method and doctrine which divide the Platonists from the Aristotelians Saint Thomas unhesitatingly and invariably takes the side of Aristotle. In fact, he is the Christian Aristotelian in the sense in which Saint Augustine is the Christian Platonist. It would, however, be fatal to a proper estimation of his philosophy to overlook the elements in it which cannot be traced to Aristotle. He was no slavish imitator; he maintained as a principle of method that the argument from authority is (in philosophy) the weakest of all arguments. It was only in the age of decay of the philosophy of the schools, when the letter rather than the spirit ruled the tradition of Thomistic teaching, his name and the name of Aristotle were invoked as authority to put an end to all discussion.

To say that Saint Thomas was an Aristotelian means little when we remember that in his day there were mere followers of Averroes, materialists and pantheists, who might with equal justice claim to be representatives of the Stagyrite. Saint Thomas was an Aristotelian who brought to the elucidation of his Master all the tradition of Christian speculation from Justin, the first of the Apologists, down to his own immediate predecessors and contemporaries. The thought which inspired the Christian philosophers was that above the order of natural truth, that is, of truth which can be attained and comprehended by the human mind unaided, there is another order of truth, the supernatural, which human reason cannot of itself attain, but which is known to us on the authority of divine revelation. Natural truth belongs to reason, and supernatural truth to faith. Christian philosophy from the beginning took its stand on the principle that these two orders of truth must, in some way, be capable of harmonious adjustment. Rationalism exaggerated the power of reason, mysticism tended to slight reason and to emphasize and unduly extend the scope of faith. Throughout the early Middle Ages these two tendencies were at war with each other in the Christian schools. It is one of Saint Thomas' chief titles to distinction that he united in his system what is true in rationalism with what is true in mysticism. The rationalism of Abelard obliterated all distinction between supernatural and natural truths, when it treated mysteries of faith as if they were conclusions of theology and used the Scriptures as if they were sources of argument in philosophy. In an opposite sense, the mysticism of Erigena removed all distinction between the two orders of truth, when it maintained that even truths of the natural order are known to us by a special *theophania*, or divine manifestation. Saint Thomas taught that the two orders of truth are distinct: that our knowledge of supernatural truth rests on the authority of revelation, while our knowledge of natural truth rests on the evidence of reason. He maintained, at the same time, that they are consonant with each other, that since God is the author of all truth there can be no contradiction between what revelation proposes for our belief and what reason proclaims to be evident. This thought, namely, that revelation is reasonable and reason divine, crystallized the fundamental concepts of all the preceding systems of Christian speculation, reconciled mysticism with rationalism and gave permanent form to the *credo ut intelligam* and the *intelligo ut credam* of scholasticism. The reconciliation of reason with revelation is of interest not merely to the Christian Apologist but to the philosopher as well. For it is inspired by the desire to establish between the supernatural and the natural that relation of continuity which Greek philosophy at the highest point of its development established between the spiritual and the material.

To the controversy concerning the mode or manner of the existence of universals, which, during the 11th and 12th centuries, had been so prominently before the minds of philosophic thinkers, Saint Thomas contributed his doctrine of moderate Realism. The Nominalists contended that universals are mere names; the exaggerated Realists, influenced for the most part by Plato, maintained that universals are things really existing outside the mind as completely developed universal forms. The doctrine of moderate Realism (q.v.) is that, while universals are not mere names but real things, they exist outside the mind not as full-blown universals but only as potentially universal essences which receive their formal aspect of universality from the mind in the act by which it compares and discusses individual objects and abstracts therefrom the formally universal concept. Saint Thomas found this doctrine established in the schools of his time. He adopted it and gave to it, as to so many other tenets of the schools, its final and most clear-cut form.

One of Saint Thomas' most noteworthy contributions to philosophy was his elucidation in the Christian and theistic sense of some of the more obscure points of Aristotelian teaching. Having before him a translation made directly from the Greek text — a translation which is, indeed, far from correct, yet which in spite of many ludicrous verbal blunders is immeasurably superior to the translations made through the medium of Syriac and Arabic — he sought to free from the accretion of Neo-Platonic and Arabian commentary the original doctrine of Aristotle on the question of the nature of the Active Intellect. Rejecting what may be called the transcendentalist view, which held the Active Intellect to be something more than human, something akin to God and in some way common to all men, he defended the anthropological view, which held that the Active Intellect is a part of the individual soul, and, therefore, not common to all, but proper to each. In this way, he strengthened the defense of the immortality of the individual soul.

Saint Thomas founded a school within the schools. To the Franciscan teachers, such as Alexander of Hales, Saint Bonaventure, and Roger Bacon, certain doctrines of Saint Augustine recommended themselves, to the detriment of the strict Aristotelianism which they professed. These Franciscan teachers were opposed by the Dominicans, who, like Albert the Great and Saint Thomas, recognized in the Augustinian doctrines in question an element of Platonism which was inconsistent with thorough Aristotelianism. The struggle between Augustinianism (q.v.) and Aristotelianism (q.v.) was waged in the schools, especially at Paris, during the first decades of the 13th century. The doctrines under discussion were

mostly psychological: for instance, the Aristotelians maintained that there is but one substantial form in man, the soul, while the Augustinians maintained that there are several substantial forms; the latter contended that there is no real distinction between the soul and its faculties, while the former defended the real distinction; the Aristotelians maintained that there are subsistent forms, that is to say, purely spiritual created substances, without any matter, while the Augustinians taught that all creatures, even the angels, are composed of matter and form. On all these questions Saint Thomas took the part of the Aristotelians and thus became the leader in the Dominican, or, as it is sometimes called, the Thomistic school in the stricter sense of the word.

The controversies between the Dominican and the Franciscan schools brought out an important general trait of Saint Thomas' philosophy. Duns Scotus (1274–1308), the ablest of the Franciscan opponents of Saint Thomas, adopting the principle of voluntarism, brought to the surface the intellectualism which pervades Saint Thomas' speculative system. Saint Thomas pushed to its utmost consequences the *intelligo ut credam* of the earlier scholastics: he made intellect superior to will and sought in every thing to find an intellectual basis for belief. Scotus maintained that on many questions of the highest importance reason fails to give a satisfactory explanation or proof and that we must fall back on will.

To say, however, that Saint Thomas was an Aristotelian in the Christian, as opposed to the Averroistic, sense; that he gave final form to the idea which inspired scholastic, and indeed all Christian, speculation; that he was a moderate Realist; that he held to the strict systematic Aristotelianism and excluded certain Augustinian and Platonic elements; that he was an intellectualist, is to give but a faint idea of his claims to pre-eminence as a representative of scholastic philosophy. Of him, as of all the great speculative thinkers, it may be said that the spirit of his work is more potent than the letter. To the modern mind, especially, he appeals in virtue of the spirit in which he undertook the work of adjusting his beliefs as a Christian to the scientific and philosophic thought of his age. To this task he addressed himself with an instinctive sense of completeness which impelled him to leave nothing incomplete or imperfect except so far as everything human is incomplete and imperfect. He brought to his task a mind appreciative of the value of truth wheresoever truth is found, whether in pagan, Jew, or gentile, and a belief — stronger in him than in any other Christian writer since Saint Augustine — that all truths and all contributions to knowledge, from whatsoever source they are derived, must be capable of harmonious adjustment.

Bibliography.— Vaughan, 'Life and Labors of Saint Thomas' (London, 1871, 2 vols.); Werner, 'Der heil. Thomas von Aquino' (Regensburg, 1858, 3 vols.); Touron, 'Vie de S. Thomas d'Aquin' (Paris, 1773); De Wulf, 'Histoire de la phil. médiévale' (Louvain, 1900), pp. 259ff; Stöckl, 'Gesch. der Phil. des Mittelalters' (Mainz, 1864ff), II., 421ff; 'Lehrbuch der Gesch. der Phil.' (Mainz, 1888), pp. 431ff; Turner, 'History of Philosophy' (Boston, 1903). For complete bibliography consult Potthast, 'Wegweiser durch die Geschichtswerke des Europ. Mittelalters' (Berlin, 1896), p. 1601.

William Turner, S.T.D.,
Saint Paul Seminary, Saint Paul, Minn.

Arabesque, ăr'a-bĕsk', a term applied to a particular species of decoration employed in Arabian and Moorish architecture. The followers of Mohammed, being prohibited by the Koran from representing the figures of men and beasts, endeavored to evade this law by inventing a series of monsters, griffins, dragons, strange birds, and chimeras; affixing the head, wings, and talons of birds to the bodies of lions, horses, and other quadrupeds; and making the upper parts of children, men, and beasts spring from among clusters of foliage and the like. In the Vatican there are paintings, executed by Giovanni da Udine from the drawings of Raphael, in this style, which are deservedly much admired.

Arabgir, ä'rab-gēr', or **Arabkir**, a town in Asiatic Turkey, 147 miles southwest of Erzeroom. It owes its enlargement and prosperity to the Armenians, who form about one fourth of the population, and it is especially noted for its manufacture of silk and cotton goods. Pop. about 28,000.

Arabi, a-rä'be, **Ahmed El** (usually known as "Bey" or "Pasha"), an Egyptian national leader: b. in Lower Egypt about 1837. He was the son of a common peasant, and, entering the army, rose to the rank of colonel and became the head of a party desiring to restore native control of Egypt. Tewfik, the khedive, too sluggish and timid to join the party openly, was nevertheless glad to see the movement prosper under the leadership of one with more energy than himself. The ministry of the ablest of Egyptian statesmen, Nubar Pasha, was presently overthrown, and Arabi made minister of war in the new cabinet. Flushed with success, the new war minister acted as if head of the state, and rashly undertook to overthrow the Anglo-French control of the finances. The bombardment of Alexandria, 11–12 July 1882, by order of the Gladstone ministry, and the rout of his army at Tel-el-Kebir, 13 Sept. following, ended his dream, and he was sent into life exile in Ceylon. He was pardoned and returned to Egypt in 1901.

Ara'bia, the peninsula in the southwestern part of Asia, called by the natives Jeziret el Arab, that is, the Peninsula of the Arabs; and by the Turks and Persians, Arabistan. It is encompassed on three sides by the sea, namely, on the northeast by the Persian Gulf, on the southeast by the Indian Ocean, and on the southwest by the Red Sea. Its extreme southern point, Ras-Arah (the Cape St. Anthony of some maps), lies in lat. 12° 35' N.; lon. 44° 4' E. Thirty miles west of it are the Straits of Bab-el-Mandeb. The extreme eastern point of Arabia, Ras-el-Had, stands in lat. 22° 23' N.; lon. 60° 5' E. A line drawn from the head of the Gulf of Suez to that of the Persian Gulf, and marking the limits of the Arabian peninsula on the north, will be found to run nearly in the 30th parallel of north latitude, but a portion of what is considered Arabia extends north of this. Arabia includes also the peninsula of

ARABIA
SCALE OF MILES
Population of places is indicated by different lettering, thus :
200,000 and over CAIRO
100,000 to 200,000 Damascus
50,000 to 100,000 Mecca
10,000 to 50,000 Aden
Smaller Places
Railroads
Routes of Travel
Telegraph Lines and Cables
MEDITERRANEAN SEA
ALEXANDRIA
CAIRO
Beirut
Damascus
Syrian Desert
El Hamed
Bisher Anase
E G Y P T
RED SEA
PERSIA
PERSIAN GULF
GULF OF OMAN
Muscat
Ras el Hadd
ARABIA
NEJD
El Shammar
Nubian Desert
NUBIA
Roba el Khaly
Belad Hajerinah
El Jehabet
El Joz
Beni Kuwelled
Beled es-Zohm
Beni Kelb
Beled el-Yafa
ARABIAN SEA
INDIAN OCEAN
GULF OF ADEN
ABYSSINIA
ADEN
Mecca
Bushire
Isfahan
Suakin
Hodeida
Mocha
Kuria Muria Is.
Socotra I.
Longitude East from Greenwich

Sinai, between the Gulf of Suez and that of Akabah. The whole area of the vast country thus described does not probably fall much short of 1,000,000 square miles.

Divisions.— According to Ptolemy, ancient Arabia consisted of Arabia Petræa, Arabia Deserta, and Arabia Felix, a division likewise followed in modern times, but which is not only founded on erroneous principles, but unwarranted by the example of the inhabitants of the country. The name of Arabia Felix, or Arabia the Happy, is derived from an incorrect translation of the word *Yemen,* which does not signify happy, but the country lying to the right of Mecca, in the same manner as the Arabic term for Syria, Al-Sham, denotes the country lying to the left of that city. Arabia Petræa likewise has been erroneously translated Stony Arabia, the epithet Petræa having been bestowed on it by Ptolemy, from the once flourishing city of Petra.

The first of the divisions met with in proceeding down the Red Sea is Hejaz, which, as it includes the sacred cities Mecca and Medina, is always set forth conspicuously by Arab geographers. It extends a short way within the mountain barrier and terminates in the south in about lat. 20° N. Next comes Yemen, which, according to some writers, embraces the whole of south Arabia; but the name is now generally used in a confined sense, Yemen proper occupying the southwest part of the peninsula, and comprising a Tehama or maritime lowland on the shores of the Red Sea, with an elevated inland district of considerable breadth. It contains the towns of Sana and Mocha. Appertaining to Yemen is Aden, now a free port in the hands of the British. Next Yemen, on the east, is Hadramaut, the western portion of which is a desert five days' journey in length. The limits of this province are, however, variously assigned by authors, some extending the name to almost the whole of the southeast coast, while others confine it to a district only 100 miles in length. Beyond Hadramaut, in the latter narrower sense, lies Mahrah, beyond which again extends the principality of Shejer or Shehr, at the eastern termination of which, near the coast, is the populous district of Dhofar, which has occasionally figured as an independent State. At the east angle of the peninsula is situated Oman. On the south shores of the Persian Gulf is Bahrein, from which, toward the head of the Gulf, extends the maritime district of Hajar, while at a short distance southwest in the interior lies the fertile district of El-Ahsa, the name of which is sometimes also given to the coast. The interior of Arabia from Hejaz and Yemen across to the vicinity of the Persian Gulf is comprised by Arab geographers under the single name of Nejed. Toward the north are the deserts of Sinai, and those of Sham, Jezíreh, and Irak (Syria, Mesopotamia, and Babylon). The two most populous districts are Yemen and Oman. See Palgrave, 'Central and Eastern Arabia' (1862–3).

The climate of Arabia resembles that of Africa. The mountains obstruct the mitigating influence of the sea breeze; scorching aridity and barrenness characterize both high and low grounds, and the date palm is often the only representative of vegetable existence. There are even districts which in the course of the year are refreshed by only one shower of rain, while a sky almost perpetually unclouded overspreads the sterile plains. The short rainy season, which, in consequence of the shifting winds prevailing in the Red Sea, visits the west coasts in our summer months, fills with water, but only periodically, the depressions in the surface, or *wadis,* and a winter marked by slight frosts occurs in the table-lands of the interior and northeast. The simoom occasionally blows during the hot season, though only in the northern districts.

Productions.— Arabia is destitute of large forests, and plains of green turf have their place supplied by steppe-like tracts, which, however, covered with aromatic herbs, afford excellent pasture to noble breeds of horses. The terrace portions of the country, which enjoy a more temperate climate, exhibit a greater luxuriance of vegetation. Here the date and cocoanut palms and various excellent sorts of fruit flourish along with durra (a species of millet which is here generally cultivated instead of European corn), the finest coffee in the world (the staple commercial product of the country), and many aromatic plants and substances, such as gum-arabic, benzoin, mastic, balsam, aloes, myrrh, frankincense, etc. There are also cultivated in different parts of the peninsula, according to the nature of the soil and climate, beans, rice, lentils, tobacco, melons, saffron, colocynths, poppies, olives, the kath bush (*Catha* or *Celastrus edulis*), the leaves of which are in general use, like those of the coca in Peru, as an excitant, sesame, the castor-oil plant, etc. In its fauna also, as corresponding with the desert nature of the country, Arabia presents much of an African type. Sheep, goats, and oxen supply man's immediate domestic and personal wants; the horse and camel are his faithful attendants on his wide peregrinations; asses and mules, of a stronger make and better appearance than those of Europe, are common in the mountainous districts; the desert is inhabited by gazelles and ostriches hurrying rapidly from oasis to oasis; and the lion, panther, hyena, and jackal crouch in ambush for the passing prey. Monkeys, pheasants, and doves are the peaceful occupants of the fertile districts, in which, however, locusts frequently commit tremendous havoc. There are several species of serpents and lizards, and scorpions and poisonous spiders are numerous. Fish and turtles abound on the coasts, and pearl oysters in the Persian Gulf. Among mineral products may be mentioned saltpetre, mineral pitch, and petroleum, which are found in the interior highlands, salt, sulphur (in Hadramaut), and several precious stones, as the carnelian, agate, and onyx. Iron, copper, and lead are far from abundant, and the country is also poor in the precious metals.

Population.— The population of Arabia has been estimated by some authorities at 12,000,000, by others at no more than 4,000,000. The former number is certainly too high, and it is believed that between 5,000,000 and 6,000,000 is nearer the truth. The Arabs present, as a nation and as individuals, much that is peculiar both in their mental and physical development. They are of middle stature, of a powerful make, and have skin of a brownish color. Their fea-

tures express dignity and pride; they are naturally active, intelligent, and courteous; and their character is marked by temperance, bravery and hospitality, along with a strong propensity for poetry. On the other hand, they are revengeful in their disposition and predatory in their habits. The women have the entire education of the children in their early years. The most fortunate events in the estimation of an Arab are the birth of a camel, a mare of noble breed bringing forth a foal, or a triumph achieved by a poet. The first religion of the Arabs, the worship of the stars, was supplanted by the doctrines of Mohammedanism, which succeeded rapidly in establishing itself throughout Arabia. Besides the two principal sects of Islam, the Sunnites (the most numerous) and the Shiites (on the east coast), there also exists, in very considerable numbers, a third sect, the Wahabees, which arose in the latter half of the 18th century, and to which the Bedouins of Nejed belong. There are also numerous Jews, who dwell among the Arabians and are chiefly employed in trade.

The whole of the west coast, comprising the districts of Hejaz and Yemen, and in quite recent times part of the east coast, namely, the republic of Koweit at the head of the Persian Gulf, and the district of El Ahsa, are more or less under the suzerainty of the Turks. The area of the western strip is about 200,000 square miles in extent, and has a population of about 1,130,000; while the eastern has an area of about 31,000 square miles and a population of nearly 200,000. Even in these districts, however, the chief offices of government are performed by the chieftains of the small territories into which the districts are subdivided. The most extensive districts politically united in the rest of Arabia are the kingdoms of Oman and Nejed, the former with an area of 81,000 square miles and a population of 1,598,000; the latter (the kingdom of the Wahabees) with an area of perhaps 200,000 square miles and a population of about 1,219,000.

The mode of life of the Arabs is either nomadic or settled, or in other words, they either live in tents and derive their subsistence from the rearing of cattle, wherever sufficient pasture is obtainable, and from the transport of caravans through the desert; or from the pursuits of agriculture and commerce. The nomadic tribes in Arabia are termed Bedouins, Beduins, or Bedawins; those following settled occupations, Hadji and Fellahs. A considerable trade, partly overland, partly maritime, is carried on, chiefly in coffee, dates, figs, spices, and aromatic substances of various kinds, though its present amount is scarcely a shadow of what it was in times previous to the discovery of the passage by the Cape of Good Hope. Commerce is partly in the hands of foreigners, among whom the Jews and Banians are the most numerous. The latter are a tribe of Indian merchants, who, however, only remain long enough in the country to enable them to return with wealth to their own land. At present the trade of Arabia is almost exclusively confined to exports of raw material or imports of foreign manufactures, domestic industry being scarcely able to supply the most necessary articles of consumption, and the inhabitants are thus rendered dependent on foreign nations for the greater portion of their manufactured commodities. The period of intellectual development among the Arabs is now indeed long past its zenith, but it does not appear yet to have sunk so low as is often assumed. Even in the desert children are taught to read, write, and cipher, and in the towns there are higher schools for satisfying the taste for scientific pursuits. The political constitution of the Arabs is patriarchal, and based on a love of freedom. The titles of the chiefs of the tribes are emir, sheikh, or imam, personages whose functions appear in general to be limited to the command of the army in war, the collection of tribute, and the administration of law by the cadis or judges.

History.— The history of the Arabs previous to Mohammed is obscure, and, owing to their slight connection with the rest of the world, of little interest. The evidence of language, tradition, and other things, establishes the fact that Arabia must have been settled at a very early date by two branches of one race. One of these branches inhabits the south and east of the peninsula (Yemen, Hadramaut, and Oman), and considers itself as forming the "pure" Arabs, while to the other branch it gives the name of Mostareb, or "Arabified." The oldest traditions regarding the origin of the former branch point to an immigration from Africa which took place about the southwest corner of the peninsula, and the physical appearance and structure of the southern Arabs, the remnants of their dialect (which is now superseded by that of the northern branch), and various institutions and customs prevailing in the parts of Arabia inhabited by them, all confirm the notion that they were originally identical with the nearest inhabitants of Africa. The northern branch, on the other hand, though bearing an unmistakable affinity with the southern, shows (in its language and other respects) more traces of Asiatic than African influence. The Arabs of the southern branch were the first to attain any considerable political power. A kingdom belonging to this branch is said to have existed in the south for upward of 2,000 years, embracing, when in a flourishing condition, the whole of the south half of the peninsula, and sometimes extending its boundaries by conquest very much farther. There is no doubt that there was actually such a kingdom, called the kingdom of Yemen, and having its capital first at Mareb and afterward at Sana, both in the district of that name; but how long that kingdom subsisted cannot be determined. Its kings belonged to the Himyarite dynasty, but this designation Himyarite is sometimes applied by Arab writers to the ruling classes of the southern branch, and sometimes to the whole branch. The Yemenite kingdom was rendered subject by the Abyssinians for upward of 70 years in the 6th century of the Christian era, during which period Christianity was proclaimed in the land. Ultimately the heir to the throne of the Himyarite dynasty was restored through the assistance of Chosroes, king of Persia (605 A.D.), but about 30 years later the kingdom was finally overthrown by the followers of Mohammed. Another Himyarite kingdom was that of Hira on the west shore of the lower Euphrates. It seems also to have extended at times to the region between the

Euphrates and the Tigris, so as to give the name of Irak Arabi to that district. The dates given for the foundation of this kingdom are widely different. Its overthrow is placed in the 5th century of our era. In the 1st century of the Christian era the Himyarite kingdom of Ghassan was founded in lower Syria and Hejaz. It lasted till the time of Mohammed. The last Himyarite kingdom that need be mentioned is that of Kindeh, which detached itself from that of Hira early in the 3d century, and lasted about 160 years. Its sway extended over northern Nejed. The divided forces of the Arabs could not always successfully resist the Roman arms, and though their country was never completely reduced to the condition of a province, yet the princes in the north at least lived in a state of dependence on the Roman emperors, and were regarded as their viceroys. In the south the Romans had no influence. An expedition was fitted out against Yemen in the reign of Augustus (24 B.C.), but it completely miscarried. With the decline of the Roman empire Arabia made vigorous struggles for independence, which could easily have been brought about by a union of the various tribes. But the Arabian peoples continued dispersed and broken, and passed many centuries in internal conflicts, during which the central highlands (Nejed) became the theatre of those chivalrous contests so celebrated by the native poets. Christianity early gained many adherents in Arabia, though it did not succeed in entirely banishing the ancient worship of the stars. Several Christian bishoprics were established, subject to the metropolitan at Bozra, in Palestine. The town of Elhira, near the Euphrates, contained many Arabian Christians and convents, and the reigning king, Ennomân-ben-el-mondsir, became a convert to Christianity not long before the time of Mohammed. The conflict of the Arabs with Roman despotism was more especially the cause of attracting to their country numbers of Christian sects, among others the Monophysites and Nestorians, seeking a refuge from the persecutions to which they were subjected by the maintainers of orthodoxy throughout the East. Jews also were very numerous in Arabia after the destruction of Jerusalem, and even made some proselytes, chiefly in Yemen. The wide differences between the various sects produced in the minds of many an indifference to all the existing religions, and was probably one of the principal causes that the doctrines of Mohammed found so speedy an acceptance in Arabia. With Mohammed a new phase commences in the history of the Arabian peoples, who are wont to designate respectively the periods before and after the appearance of the Prophet as those of ignorance and knowledge. Mohammed belonged to the Mostareb, and among them to the tribe of Koreysh, which had occupied a position of great influence in Arabia since the beginning of the 5th century, when it managed by craft to obtain possession of the city of Mecca, which was not only a city of great commercial importance, but was regarded as sacred by the Arabs on account of its containing the Kaaba. During the whole of the 6th century the Mostareb generally were increasing in power, and by the beginning of the 7th, when Mohammed had grown to manhood, they had absorbed the kingdom of Kindeh, and had extended their sway at the expense of those of Yemen, Hira, and Ghassan. By the time of Mohammed's death, in 632, his religion had acquired a firm hold in Arabia, and after that event his successors, acting on the commands of the Koran, began to spread it by force of arms beyond the bounds of the peninsula. The nation, now for the first time acting as a body, played for several centuries an important part in the world's history, advancing in a career of victory beyond its natural frontiers, to found empires in three quarters of the globe. The brilliant period of Arabian history, indeed, as regards foreign countries, came to a termination in Asia in 1258, on the fall of the caliphate of Bagdad, as also about the same time in Africa and Europe, in the latter of which the Moorish dominion was finally overthrown (in the kingdom of Granada in Spain) in the last decade of the 15th century; yet the epoch of the Arab sway must ever occupy a distinguished place in the intellectual history of mankind. The internal history of the country during its foreign conflicts presents little more than unimportant accounts of some Bedouin tribes, and the fortunes of the caravans which made the annual pilgrimage to Mecca. In 1517 Turkey subjected Hejaz and Yemen, and received the nominal submission of the tribes inhabiting the rest of Arabia. The subjection of Hejaz has continued down to the present day, with a brief interval in the latter half of the 16th century, and another longer interval in the 19th century, when the pasha of Egypt was dominant in Arabia; but Yemen achieved its independence in 1630 and maintained it till 1871, when the territory again fell into the hands of the Turks. In 1839 Aden, in Yemen, was occupied by the British.

In the east Oman became virtually independent of the caliphs in the middle of the 8th century, and grew into a well-organized kingdom. In 1507, however, its capital, Maskat or Muscat, was occupied by the Portuguese, who were not driven out till 1651. Oman was temporarily subjugated by the Persians under Nadir Shah in the first half of the 18th century. They were expelled by Saood, who was made imam of Oman, and under whom it extended its sway over part of the opposite coast of Persia as well as the islands lying between and over the coast of Zanzibar. Since 1867 the kingdom of Oman has been again confined to the mainland of Arabia. The appearance of the Wahabees about the middle of the 18th century is the first event since the time of Mohammed that affected Arabia generally. The moral effects of this event exercise still a powerful influence; the political were soon effaced by the ruler of the neighboring country of Egypt. Mehemet Ali, pasha of Egypt, subdued the coast of Hejaz, as also several places on that of Yemen, and in 1818, by means of a great victory gained by Ibrahim Pasha, and the destruction of their capital city Derreyeh, put a stop to the further extension of the Wahabite power. He also expended large sums in the maintenance of his sway in Arabia, which secured to him the trade of the Red Sea. The events of 1840, however, in Syria, compelled him to concentrate his forces, and he soon found himself obliged, as thwarting the Euro-

pean line of policy, to renounce all claims to the territories lying beyond a line drawn from the Dead Sea to the Gulf of Akabah. The Hejaz thus again became immediately subject to Turkish sway. Turkey has since extended its rule not only over Yemen as already mentioned, but also over the district of El Ahsa on the Persian Gulf; but the extreme weakness of the Turkish empire scarcely warrants the expectation that its tenure of power in Arabia will last very many years longer.

Language.— The Arabic language belongs to the Semitic dialects, among which it is distinguished for its richness, softness, and high degree of development. By the spread of Islam it became the sole written language and the prevailing speech in all southwestern Asia and eastern and northern Africa, and for a time in southern Spain, in Malta, and in Sicily; and it is still used as a learned and sacred language wherever Islam is spread among people who in daily life speak Indian, Persian, or other languages. The study of Arabic is important not only on account of the wide area over which it is still spoken and the extensive literature it contains, but also because it is almost an indispensable preliminary to the study of some of the other languages of the East. Almost a third part of the Persian vocabulary consists of Arabic words, and there is the same proportion of Arabic in Turkish. A scientific treatment of the Hebrew language first became possible through comparing it with the Arabic. The characters originally used in writing the Arabic language were borrowed from the old Syrian Estrangelo alphabet, which, however, was very inadequate for the purpose, having only 16 signs for the 28 Arabic consonants. This alphabet is now superseded by the Neski. As in all Semitic languages (except the Ethiopic) it is read from right to left. There are valuable Arabic grammars by Erpen (1613), De Sacy (1831), Ewald, Caspari, Wolff (2d ed. 1867); and in English by Wright (based on that of Caspari, but practically a new work, 1874–5), and Palmer (1874). The great standard Arabic-English dictionary is that of E. W. Lane (continued by his nephew, Lane Poole, a most extensive work). Other valuable works are Richardson's 'Persian-Arabic-English Dictionary'; Newman's 'Dictionary of Modern Arabic' (1871); Badger's 'English-Arabic Dictionary' (1881); and Salmoné's 'Arabic-English Dictionary' (1890).

Literature.— Of the first cultivation of the literature of this country we have but few accounts. That poetry early flourished in Arabia may be inferred from the character of the inhabitants, who are at the present day much given to poetry. In the fairs of Mecca and (from the 5th century after Christ) at Okadh, poetical contests were held, and the poems to which the prize was awarded were written on byssus in letters of gold, whence they were called *Modsahhabat* (gilt), and hung up on the wall of the sacred temple containing the kaaba at Mecca, on which account they also got the name of *Moallakat* (hung up). The collection of the Moallakat contains seven poems by seven authors — Amr-ul-kais, Tarafa, Zohair, Lebid, Antar, Amr-ben-Kelthum, and Hareth. They are distinguished by deep feeling, lofty imagination, richness of imagery and sentiment, national pride, and love of freedom. Many other poems belonging to the time before Mohammed, some of equal age with those of the Moallakat, are also preserved in collections. The influence of Mohammed gave a new direction to Arab poetry. The rules of faith and life established by him were collected by Abubekr, first caliph after his death, corrected and published by Othman, the third caliph, and constitute the Koran. The warlike times of Mohammed and the first caliphs, however, were not favorable to the cultivation of literature. The progress of the Arabs in the arts and sciences may be said to have begun with the government of the caliphs of the family of the Abassides, A.D. 750, at Bagdad. Here Haroun al Rashid (786–808) invited learned men from all countries and paid them princely salaries. He caused the works of the most famous Greek writers to be translated into Arabic and spread abroad by numerous copies. Under the government of Al Mamum (813–33) excellent schools were established at Bagdad, Bassora, Bokhara, Cufa, and large libraries at Alexandria, Bagdad, and Cairo. The caliph Motassem, who died A.D. 842, was of the same disposition, and while literature was thus favored by the dynasty of the Abassides in Bagdad, it received not less encouragement from that of the Ommiades in Spain. What Bagdad was for Asia, the university at Cordova was for Europe, where, particularly in the 10th century, the Arabians were the chief pillars of literature. At a time when learning found scarcely anywhere else a place of rest and encouragement, the Arabians employed themselves in collecting and diffusing it in the three great divisions of the world. In Spain were established numerous academies and schools, which were visited by students from other European countries; public libraries were collected, one of them said to contain 600,000 volumes; and important works were written on geography, history, philosophy, medicine, physics, mathematics, and especially on arithmetic, geometry, and astronomy. There are a number of terms still in use, such as almanac, algebra, alcohol, azimuth, zenith, nadir, which were borrowed originally from the Arabs. The most of the geography in the Middle Ages is the work of the Arabians. Among their chief writers on geographical subjects are El-Istakhri, 'Liber Climatum', edited by Möller (1839); Abu-Ishak-al-Faresi, Ibn-Haukal, who wrote about 815, 'El-Edrisi,' 1150 (French translation published by Jaubert 1836); Yakuti, who died in 1249, and Abulfeda; and much that the most renowned among them, Abulfeda and Edrisi, have written, is still useful and important in regard to historical geography. Even more important than the geographical text-books are the descriptions of countries which were written by Arab travelers; such as those by Ibn-Foslan, who traveled in Russia in the 9th century; by Mohammed ibn-Batuta, who traveled in Africa, India, China, Russia, etc., in the 13th century; and by Leo Africanus, who traveled in Africa and Asia in the 15th century.

The Arabian historians since the 8th century have been very numerous, though not yet long enough known to European scholars to enable the latter to derive full advantage from them. The oldest known historian is Hesham

Ben-Mohammed Al-Kelbi (died 819). Several other historians lived in the same century. Masudi, the Persians Tabari and Hamsa of Ispahan, and the Christian patriarch Ibn el Batrik or Eutychius of Alexandria, were the first that attempted universal histories. These were followed by Abulfaraj and George Elmakin, both Christians, Abulfeda, Nuvairi, Alfachri, and others. Native historians wrote on the history of the Arabs in Spain and in Mauretania; others, such as Abdullatif and Makrisi, wrote on the history of Egypt; others compiled biographical dictionaries or wrote lives of individuals. The style of most of the historians is simple and void of ornament. Indeed their histories are little more than voluminous chronicles. The philosophy of the Arabians was of Greek origin and derived principally from that of Aristotle, who through them became known in Spain and thence in all the west of Europe, having been translated from Arabic into Latin. Hence the origin of the scholastic philosophy may be traced to the Arabians. The Arabians seem to have become acquainted with the works of the Greek philosophers in Bagdad, where a knowledge of them was disseminated by the Nestorian Christians who had been expelled from Syria in the 5th century and found refuge and patronage in Persia. During the 8th and 9th centuries numerous versions of the principal works of Aristotle were made into Syriac and thence into Arabic; and once Aristotle had been introduced to their knowledge the Arabian philosophers both in the east and the west did little else than advance nearer and nearer to a faithful interpretation of that master. Of their philosophical authors the most celebrated are Alfarabi (died 950), who wrote on the principles of nature; Ibn Sina, or Avicenna, who was born about 980 and died A.D. 1037, and, besides other philosophical writings, was the author of a treatise on logic, physics, and metaphysics, and of a commentary on the works of Aristotle; Alghazzali (1058–1111), who wrote a work attacking all heathen philosophical systems; and in Spain Avicebron (died 1070), a Jew, the same with Solomon ben Gebirol; Ibn Badja, known to Europeans as Avempace (died 1138); Ibn Tofail (died 1190); and (one of the greatest of them all) Ibn Roshd, or Averroes (1126–98). Of these, Avicenna was by far the most important, and his influence on Western thought was considerable.

Nearly all the Arabian philosophers were at the same time physicians; for the physical sciences, including medicine, were not then separated from philosophy. At Jondisabur, Bagdad, Ispahan, Firuzabad, Bokhara, Cufa, Bassora, Alexandria, and Cordova, from the 8th to the 11th century medical schools were instituted, and with the devoted study bestowed on this branch of science the nation could not fail of making important advances in it, though in reality they were here also dependent on the Greeks. Anatomy made no progress among them, because the Koran expressly prohibited dissections. To their famous writers on medicine belong Aharun (who first described the smallpox), Jahiah Ben Serapion, Jacob Ben Ishak Alkendi, John Mesve, Rhazes, Ali Ben Abbas, Avicenna (who published the 'Canon of Medicine,' for a long time the best work of the kind), Ishak Ben Soleiman, Abulcasim, Ibn

Zohar, Averroes (the author of 'A Compendium of Physic'). Mathematics the Arabians enriched, simplified, and extended. Mohammed Ben Musa and Thabet Ben Korrah particularly distinguished themselves in this department. Nassireddin translated the 'Elements' of Euclid. Jeber Ben Afla wrote a commentary on the 'Trigonometry' of Ptolemy. Astronomy was especially cultivated, there being famous schools and observatories at Bagdad and Cordova. As early as A.D. 812 Alhazen and Sergius had translated into Arabic the 'Almagest' of Ptolemy, the first regular treatise on astronomy. Albatani, in the 10th century, noted the advance of the line of the earth's apsides and the obliquity of the ecliptic. Alpetragius wrote a theory of the planets. Geography was treated scientifically, in connection with mathematics and astronomy, particularly by Abulfeda. The Arabian scholars devoted much time to grammar and rhetoric, particular attention being paid to expounding the Koran and in preparing works dealing with it.

Much as the severer sciences were cultivated the genius of the people for poetry was not fettered. After the 9th century the Oriental peculiarities of Arabian poetry became more and more strong; the tone grew mystical and extravagant and the language lost its purity. Motenabbi deserves to be noticed for his tender elegies in a classic style; Abu Ismael Tograi, vizier of Bagdad, for his elegies and poems; Hariri for his history of an unscrupulous but amusing vagabond in his work entitled 'Mekammat,' admirably translated into German by Rückert, into English by Chapellon and Preston; Ibn-Arabshah for his narrative tales, etc.; Asmai for his great heroic romance, 'Life of Antar.' The dramatic excepted, there is no sort of poetry which the Arabians have left unattempted. There is no doubt that they had by this means a powerful effect on modern European poetry, for no small share of the romantic poetry of the Middle Ages belonged to the Arabians. The tales of fairies, genii, enchanters, and sorcerers in particular passed from the Arabians to the Western poetry. Some of the books most widely read in the Middle Ages, such as 'The Seven Wise Masters' and the 'Fables of Pilpay,' found their way into Europe through the instrumentality of the Arabs. To this rich and many-sided intellectual life among the Arabs in the Middle Ages the intellectual poverty of the 19th and past two or three centuries offers a striking contrast. Arab literature now scarcely offers anything worthy of notice. Learning is chiefly confined to the production of commentaries and scholia, discussions on points of dogma and jurisprudence, and grammatical works on the classical language. Among authors who have written to a certain extent under the influence of European culture we must mention Michael Sabbagh of Syria ('The Carrier Pigeon,' Arabic and French, Paris 1805); Sheikh Refaa of Cairo ('The Broken Lyre,' Paris 1827; 'Manners and Customs of the Europeans,' Cairo 1834); Nasif-Effendi of Beyrout, and Ahmed Faris (died 1887), journalist and miscellaneous writer. Translations of modern European works (Jules Verne's and others) are numerous. A number of periodicals are published in Arabic.

Ara'bian Nights Entertainment, The, a celebrated collection of Arabic tales, first introduced into Europe in the beginning of the 18th century by means of the translation of Antoine Galland, a distinguished French Orientalist, which was hailed with universal delight, and soon became one of the most popular works in Europe. The story which connects the tales of the 'Thousand and One Nights' is as follows: The Sultan Shahriyar, exasperated by the faithlessness of his bride, made a law that every one of his future wives should be put to death the morning after marriage. At length one of them, Shahrazad, the generous daughter of the grand vizier, succeeded in abolishing the cruel custom. By the charm of her stories the fair narrator induced the Sultan to defer her execution every day till the dawn of another by breaking off in the middle of an interesting tale which she had begun to relate. The delight felt by Shahriyar has been felt by multitudes since his time, and the universal popularity of the 'Arabian Nights' is unequivocally evinced by the numerous translations in different European languages which have appeared since the time of Galland. Lane, who resided for years at Cairo and published an excellent (abridged) translation of these tales, with numerous most valuable notes (1839), considered that they took their present form some time between 1475 and 1525. A complete (unexpurgated) translation of great value by Sir R. F. Burton has been published (1885–6), with a somewhat abridged edition by Lady Burton (1887–8). There is also a modern translation by Mr. Payne (1882–4).

Ara'ceæ, the designation of an order of endogenous plants having for their inflorescence a spadix placed within a spathe. They have neither calyx nor corolla. The leaves are frequently cordate; the fruit succulent, with many seeds. They are acrid in character and often poisonous. The *Caladium sequinum*, or dumb cane of the West Indies and South America, when chewed, causes the tongue to swell so as to cause temporary dumbness. A common English species is the wake-robin. The nearest relatives of the family in America are the Indian turnip, water-arum, and skunk's cabbage.

Arach'nida, the name applied to the class of arthropods represented by the scorpion, spider, and mite. The body is divided into two regions, the cephalothorax and abdomen, the head having been in embryonic life folded back over and fused with the thorax. There are no antennæ, the first pair of appendages resembling mandibles, and called cheliceræ; the second pair end in a large forceps, or chelæ, or in a palpus-shaped appendage called "pedipalpi." The head appendages are not differentiated into antennæ, mandibles, maxillæ, and maxillipeds, as in *Crustacea*. There are four pairs of legs ending in a pair of minute claws. On the abdomen there are no appendages. The respiratory organs are spiracles opening into tracheas or air-tubes, or pouches containing numerous leaves or their sacs, resembling the leaves of a book, and hence called "book-lungs." The eyes are simple, never compound, two being situated in the middle of the head, others on each side of it. There may be as many as five pairs of nephridia. The genital outlet is single instead of being double, as in *Limulus*. They have a pair of malpighian tubes or urinary vessels, but, like *Limulus*, possess two large digestive glands, the "liver."

The young are hatched in the form of the adult, there being no metamorphosis except a slight one in the mites. Their embryos have, on at least six abdominal segments, rudiments of limbs, which indicate their descent from animals like *Limulus*. All of the *Arachnida* are terrestrial, none of them living in or near fresh-water, except a few mites. Their embryology is like that of *Limulus*, which suggests that the *Arachnida* have descended from the *Merostomata* (q.v.). Whether we take into account the mode of development or the very primitive nature of the appendages, it appears that the *Arachnida* are much less closely allied to insects than was formerly supposed. On the other hand, they differ from the merostomes, and especially their living representative, the king crab (q.v.), in having no gills. Their embryology and morphology tend to show that the class has probably descended from limuloid ancestors, of which there are examples in the Silurian rocks, intermediate between limuloid (*Xiphosura*) and eurypteroid (*Eurypterida*) forms. The characters in which *Arachnida* resemble insects, as respiration by tracheæ and the presence of urinary tubes (which do not occur in *Crustacea* or in any other marine or branchiate arthropods), are probably adaptive and were acquired during a change from a marine to a terrestrial life, and not primitive heirlooms. *Arachnida* also show their later origin than merostomes by the fact that their sexual ducts (oviduct, etc.) are in most cases single, unpaired, and in all cases open externally by a common single genital aperture in the median line of the body, at the base of the abdomen. In this respect *Limulus*, with its pair of genital (male and female) openings, situated each at the end of a papilla, which are placed widely apart at the base of the first abdominal legs, is decidedly more archaic. The *Arachnida* are divided into six groups or orders: (1) *Scorpionida* (scorpions); (2) *Pseudoscorpionida* (false- or book-scorpions); (3) *Pedipalpida* (*Phrynus* or scorpion-spiders); (4) *Solpugida* (galeodes); (5) *Phalangida* (harvest men); (6) *Araneida* (spiders); (7) *Acarida* (mites and ticks), the latter comprising the aberrant and degenerate forms, many of them parasitic; while of somewhat doubtful relationship to the *Acarina* are three aberrant groups: the *Linguatulida, Pycnogonida,* and *Tardigrada*. See MITE; SCORPION; SPIDERS.

Several of the *Arachnida* are of interest in medicine. A few of the scorpions are poisonous, their sting even causing death, although it is quite certain that there are no poisonous spiders north of Mexico. A number of the mites are found in man. One, the *Demodex canis*, is frequently found in the sebaceous follicles of the skin, notably in comedos, or blackheads. The itch mite (*Sarcoptes scabeii*) bores little canals under the skin, in which it deposits its eggs. The itch is a common disease of Europe, and is becoming more frequent in this country. Sulphur ointment is one of the best parasiticides for this small nuisance.

In the warm countries ticks (*Ixodes*) are troublesome pests. See PARASITES.

Arago, ä'rą-gō, **Dominique François**, a celebrated French astronomer: b. in Estagel, 1786; d. in Paris 2 Oct. 1853. After studying at the Polytechnic School at Paris he was appointed secretary of the Bureau des Longitudes, and in 1806 was associated with Biot and in completing the measurements of Delambre and Mechain to obtain an arc of the meridian which was to serve as the basis of a new metrical system. In 1809 he was elected to fill the seat left vacant by the death of Lalande in the Academy of Sciences, and at the same time he was appointed a professor of the Polytechnic School. In 1811 he communicated to the Institute a paper on a particular modification which the luminous rays experience in their passage through certain transparent bodies, thus paving the way for some of the most brilliant discoveries made in optical science since the days of Newton. In 1812 he began a series of lectures on astronomy, which created an immense sensation. With Gay-Lussac he established in 1816 the ‹Annales de Chimie et de Physique.› His discovery of the magnetic properties of substances devoid of iron procured him the Copley medal of the Royal Society of London in 1825, and a further consideration of the same subject led to the equally remarkable discovery of the production of magnetism by electricity. In 1830, on the death of Fourier, Arago succeeded him as perpetual secretary to the Academy of Sciences, becoming in the same year director of the Observatory. After the expulsion of the Bourbons Arago was elected to the Chamber of Deputies as representative of the Pyrénées-Orientales, taking his place on the extreme left, and proving a ready and effective speaker. The revolution of 1848 brought him still more prominently upon the scene, first as minister of war and marine in the provisional government, and then as a member of the Executive Committee of the National Assembly. His ‹Works,› edited by Barral, appeared in 1854–62.

A'ragonite, a mineral having the formula $CaCO_3$, and therefore identical with calcite in composition. It is classed as a separate species, however, because it crystallizes in the orthorhombic system. Its specific gravity is also somewhat higher than that of calcite. Occasionally it contains a little strontium, lead, or zinc, and it often occurs in connection with pyrites, galena, or malachite. It is translucent and usually white with a vitreous lustre. In hardness it varies from 3.5 to 4, and it has a specific gravity of about 2.94. Aragonite occurs in fine crystals at Aragon, Spain (whence its name), near Bilin, Bohemia, in Hungary, and Sicily, and near Frizington, England. There are no important American localities, though it occurs on stalactitic calcite in caves in New Mexico, Arizona, and elsewhere. The coralloidal form, called «flos-ferri,» is most beautifully developed in Styria. It is said to be forming rapidly at the present time in the Eureka mine in Nevada.

The minerals aragonite, bromlite, witherite, strontianite, and cerussite, all of which are carbonates crystallizing in the orthorhombic system, are classed together as the «aragonite group.»

Ara'lia, the designation of a widely distributed genus of about 400 species of dicotyledonous shrubs, trees, and perennial herbs typical of the natural order *Araliaceæ*. The species have large alternate deciduous leaves, small umbels of whitish flowers usually arranged in panicles, and 2- to 5-seeded, variously colored, globular, berry-like drupes. All parts of the plants have a warm, aromatic taste. *A. spinosa*, devil's walking-stick, angelica tree, Hercules' club, toothache tree, a very ornamental shrub or small tree about 12 feet tall (sometimes 40 feet), is common in moist woods and along river banks from Pennsylvania to Indiana and southward to the Gulf of Mexico. Its very stout, prickly stems, large pinnate leaves, and clusters of flowers which appear in midsummer, give a decided sub-tropical effect upon lawns in the South. It is not hardy in the North. *A. racemosa*, spikenard, a widely branched herbaceous species, with large, spicy, aromatic roots and greenish-white flowers which appear in midsummer, is common in rich woods from New Brunswick to Minnesota and southward to the mountains of Georgia. *A. nudicaulis*, wild sarsaparilla, small spikenard, a nearly stemless herbaceous species with a single pinnate leaf a foot high, is common in rocky and sandy places from Newfoundland to Dakota and southward to the mountains of North Carolina. It bears from two to seven umbels of greenish flowers in late spring. The long, horizontal, aromatic roots are believed to be equal to those of sarsaparilla as an alterative and tonic. *A. hispida*, wild elder, bristly sarsaparilla, a bristly stemmed perennial found in the same localities and soils as the preceding. It bears several terminal umbels of white flowers in early summer. Among foreign aralias the Asiatic species are perhaps of most importance. Some, notably *A. edulis* (*A. cordata* of some botanists), are of value as human food; others as stock food when grasses are scarce. The pith of *A. papyrifera* (referred by some botanists to *Fatsia papyrifera*) is used for the manufacture of Chinese rice paper. *A. chinensis*, Chinese angelica tree, is much like its American relative, *A. spinosa* (to which it is referred by some botanists), but is hardier and blossoms somewhat later. *A. polaris* (*Stibocarpa polaris* of some authors), a New Zealand herbaceous perennial, is four or more feet tall and has attractive foliage and handsome waxy flowers. Many other species are cultivated either out of doors or in greenhouses for ornamental purposes, for which uses their symmetry and grace specially fit them. Among the best known of these are *A. elegantissima*, a native of New Hebrides, and *A. veitchii*, indigenous to New Caledonia. The stronger growing species are propagated by cuttings of roots or stems; the more delicate by grafting on the strong species. For *A. quinquefolia*, better known in America as *Panax quinquefolia*, see Ginseng.

Aransas (ą-răn'zăs) **Bay**, an inlet on the coast of Texas, connected with the Gulf of Mexico by a channel known as Aransas Pass. A bar at its mouth renders its harbor of very little commercial importance, in spite of the money lavished in various attempts to establish there a harbor and port of entry. During the Civil War it was the scene of a conflict between the Confederate and Federal troops.

Ar'arat, or **Pilot Mountain**, an American mountain about 3,000 feet in height, in Surrey County, N. C. It is situated between the Ararat and Dan rivers and is visible for a long distance.

Aras, a-räs, a river of Armenia, rising in the Turkish pashalic of Erzerum. After flowing for some miles through Turkish territory to the new Russian frontier, it turns eastward to the Ervian plain north of Ararat, whence it sweeps in a semicircle mostly between the Russian and Persian territories to its confluence with the Kur, 60 miles from its mouth in the Caspian Sea. Its entire course is about 500 miles. Modern research has discovered that it originally flowed directly into the Caspian Sea, as ancient writers had claimed. It is identical with the ancient Araxes.

Arauca'nians, ä'row-kä'ne-ans, a South American native race in the southern part of Chile, formerly occupying Chile, Argentina, Chiloe, and the Chonos Archipelago, etc. When first encountered by the Spaniards in 1535 they were a confederacy of the loosest kind, with many tribes and sub-tribes in entire independence, and in about the same political stage as the North American Indians: electing a *toqui* or war-chief and deposing him at will, with no authoritative head in peace, practising polygamy, and for worship conciliating an evil spirit, Quecubu,— probably the same as the Fuegian spirit immortalized by Shakespeare as "Setebos," the shape given it by Magellan's sailors. They were divided into Picun-che or Northmen, living north of the river Maule; Pehuenche or Pine-men, occupying through central Chile and the pine forests on the western slopes of the Andes (the chief division of the tribe, and from whom most of the modern Araucanians are descended); Huilli-che or South-men, occupying the rest of the Chilean mainland; Puelche or East-men; South-men or Patagonians; Chono; Lubu-che or Water-men; Cuncho; Payo, etc. But their instant and indomitable cohesion in face of the Spanish attack shows that they were of much higher political stamp than the North Americans. No other native race in the western hemisphere retained its independence anything like as long. For over two centuries they waged warfare with the Spaniards, broken only by truces sought by the latter, though their numbers were small compared with the Aztecs or Quichuas, who went down at a blow. Ercilla's famous epic 'Araucana' commemorates their early heroism and that of their powerful chief, Caupolican. In 1641 Spain conceded their independence, confirming it in 1655, imposing only the condition that no enemies of Spain should be allowed to enter their country; an easy condition, as it amounted only to keeping out all foreigners, which they were glad to do. The territory left them was about 30,000 square miles, from the Andes to the sea, and from Arauco Bay to the river Calle-Calle. The war was renewed nevertheless, and went on a century and a third longer; till in 1773 the natives, weakened by war and social practices, were compelled to submit. They had not lost the memory of their past, however, and in 1861 a French adventurer named Antoine Tounens, originally a provincial lawyer, had himself elected king of Araucania as Orélie Antoine I.; but the Chilean government conquered and deposed him and sent him back to France. In 1870 the Araucanians recognized the sovereignty of Chile. Araucania occupies a great part of the province of Arauco in south Chile, and is divided into four parallel north-and-south districts, each formerly governed by a *toqui* whose rule had become hereditary before its extinction. The inhabitants are now a mixed race with much Spanish blood. They number perhaps about 50,000, but are said to be decreasing, owing to smallpox, dysentery, liquors, and polygamy. They are of a pale yellow color, and in character and life resemble the higher North American plains Indians, such as the Navajos. They are uncivilizable and unchristianized; nomad herdsmen of horses, cattle, and sheep; despising agriculture, eating little but meat, and living in skin tents; but skilful wool-weavers, skin-dressers, and weapon-makers. Their language is so harmonious and flexible that an enthusiastic missionary student once attempted to introduce it into Europe to supersede Latin. Their stock in Chiloe are called Chilotes.

Ar'auca'ria, the name of a genus of 15 species of lofty evergreen trees of the order *Coniferæ*, indigenous to Australia and South America. In general habit the species resemble the pines, but have broader leaves. In warm but not excessively dry climates they are much planted for ornament, but in cool countries are grown in greenhouses on account of their tenderness. They are propagated by seeds and cuttings planted in good soil and grown in a cool greenhouse. *A. excelsa*, Norfolk Island pine and its varieties, *glauca* and *robusta compacta*, unquestionably the most popular species grown in the United States, is imported to the extent of probably 250,000 annually, from Belgium, where it is grown in immense quantities. In Norfolk Island, its home, it often attains a height of 200 feet (100 feet to the first branches) and a diameter of 10 feet near the base. The white, close-grained tough wood is so heavy that it barely floats in water. *A. cunninghamii*, hoop pine, Moreton Bay pine, colonial pine, coonam, cumburtu, coonong, a native of New South Wales, is similar to the preceding, but somewhat smaller, of less formal and symmetrical habit. Its lower branches are horizontal, its upper ascending; one of its varieties, however, is weeping. Its yellowish wood is highly valued for carpentry, shipbuilding, and furniture-making. It also furnishes a valuable resin. *A. imbricata*, Chile pine, monkey puzzle, a native of the western slopes of the Chilean Andes, attains a height of 150 feet, and is limbless except near the top. It furnishes an abundant supply of valuable white resin which smells like frankincense. Its timber, which is used for ships' masts, is yellowish white, handsomely veined, heavy, and hard. Its huge cones, often eight inches in diameter, frequently contain several hundred seeds, which are largely used as food, either raw, roasted, or boiled, by the Chileans, who also distil a liquor from them. *A. braziliana*, Brazilian pine, a native of southern Brazil, is a more spreading species than the above, which seldom greatly exceeds 100 feet in height. Its seeds are also used as food; its resin for mixing with wax in candle-making. *A. Bidwellii*, bunga-bunga, of Australia, attains a height of 150 feet and a diameter of four feet. It furnishes a less valuable timber than *A. cunninghamii*, an important resin, and every three years a crop of large seeds used by the natives as food. It rivals *A. excelsa* in beauty as

a pot plant. *A. cookii*, named after Capt. Cook, the explorer, reaches a height of 200 feet, and *A. pulei*, both natives of New Caledonia, are useful for ornamental purposes and for their products of timber, resin, etc. In California and the southern States these trees have been found to succeed well as out-door specimens.

For cultivation consult Bailey, 'Cyclopædia of American Horticulture'; Nicholson, 'Dictionary of Gardening'; Von Mueller, 'Select Extra-Tropical Plants Readily Eligible for Industrial Culture.'

Arauco, a-row'kō, the name of a province of Chile with an area of 4,248 square miles. It is but a strip of coast at present, but was formerly much more extensive. Capital, Lebu. Pop. (1901) 75,000.

Araujo de Azevedo, a-row'zhō dā ä-za-vā'do, a noted Portuguese statesman: b. in Sa, 1754; d. in Rio Janeiro, 1817. He became minister of foreign affairs in 1803, but on the capture of Lisbon by Napoleon in 1807 accompanied the king to Brazil. At Rio Janeiro he founded schools of fine arts and medicine, introduced the tea culture into Brazil and was an active patron of agriculture and other industries. In 1815 he was created Count of Barca. His literary pretensions were not inconsiderable.

Araujo Porto-Alegre, a-row'zhō pôr'tō-a-lā'grā, **Manoel de,** a Brazilian poet and architect: b. Rio Pardo, 1806; d. 1879. He not only designed several important buildings in Rio Janeiro, but was the author of several comedies, of 'Colombo,' an epic, and 'Brasilianas,' a collection of poems (1863).

Arauna, ä'ra-oo'na, the name of a South American tribe whose home is on the borders of Peru and Bolivia, regarding whose appearance and customs travelers differ widely. According to some accounts they are naked and ill-formed cannibals, while according to others they are light-colored, mild-mannered agriculturists.

Araure, a-row'rā, a town in Venezuela in the State of Lara, the centre of a fertile region producing coffee, cotton, and cattle. The battle of Arame took place near here, 4 Dec. 1813. Pop. 4,000.

Aravulli, ăr'a-vul'le, or **Aravalli,** a mountain range in Hindustan about 300 miles in length. Its river system is extensive, but the valleys enclosed within the range are mainly sterile.

Arawakan (ä-ra-wä'kan) **Stock** (from the Arawaks below), the most widely diffused linguistic stock of South America, and originally forming a curious and significant link between the South and North American regional if not philological stocks. Their habitat reached from Bolivia and southern Brazil not only to the northern coast of Venezuela, but — while barred to the westward by the Colombian Chibchas or Muyscas of the Magdalena basin — occupied the entire West Indies and had an outlier of several villages in Florida. Just before Columbus' discovery, however, they had been expelled from the southern Antilles and part of the adjoining South American coast by the fierce Caribs (q.v.) from the lower Orinoco, who had seized their women for wives, most of the latter still speaking Arawal when the Spaniards found them. The larger Antilles were still Arawak, and the names given in the early West India voyages are intelligible in this set of languages yet. The Arawakans have neither the energy and cohesiveness of the Araucans, the splendid physique and fiery vigor of the Caribs, nor the political development of the Quichuas in the past; they are below the medium stature, and of no great stamina. Yet they had, perhaps owing to this very lack of savage vigor, an intellectual and artistic development and a stage of culture above the surrounding tribes: they made fictile vases decorated with grotesques of men and animals, were skilful artisans in stone, gold, and wood, and excellent weavers; and the island Arawakans cultivated not only corn and manioc for food, but cotton and tobacco, whose use the Europeans took from them. There are probably a hundred or more different tribes of this stock scattered through Brazil, Bolivia, the Guianas, Venezuela, and Colombia. Among the chief, besides those mentioned below under Arawaks, are the Manaos near that city, at the junction of the Amazon and Negro; the Waupes, Maipures, and Miranhas, in the extreme west of Brazil next to Colombia, on the llanos between the Negro and Amazon; the Goajiros on that peninsula west of the Gulf of Venezuela; the Piaroas on the Orinoco near its junction with the Meta; the Maneteneris in the northwest angle of Bolivia; the Baures and the Moxos or Mojos in northeast Bolivia, next Matto Grosso; and the Antas in extreme south Brazil, near Uruguay.

Arawaks, ä'ra-wäks (name most improbably defined "meal-eaters"— that is, of cassava bread — from a Tupi word: not more descriptive of them now than the Tupis or any other South American race except the Araucanians, and they hunt and fish as well as raise corn and manioc. Their own name is Lokono or Lukkunnu, "men": cf. Illinois, Innuit, Muysca, Alemanni, etc.), a tribe of South American Indians living on the coast of British and Dutch Guiana, across the Corentyne and Berbice rivers, and taken as the type of the great Arawakan stock (above). They are not pure-blooded, however, being mixed with Caribs, etc., in a conglomerate of plantation laborers. The term is also used in a broader sense to include all the tribes of this stock in British Guiana and the neighboring corner of Brazil, with the extension noted into Dutch Guiana: Tarumas and Atoradis of the upper Essequibo basin, Wapisianas of the upper Rio Branco in Brazil, etc., as well as Arawaks proper. All these are in a very primitive stage of culture, making marriages by abduction after orgies on corn spirits, counting descent through females, having the clan system, and practising the couvade (q.v.). The Atoradis are almost white, or not duskier than South Europeans, with fine figures, especially the women having much beauty and dignity of appearance. The Wapisianas are browner and less graceful, but their language is so soft, sonorous, and vocalic that it is the general medium of communication for trade and other intercourse among all the tribes in this region, even the Caribs; and the Atoradis have nearly abandoned their own for it.

Arax'es. See Aras.

Arayat, a-rī'at, a Philippine town on the island of Luzon, occupied by the American army 12 Oct. 1899. Pop. 14,000.

Arba'ces, a Median general under Sardanapalus and the founder of the Median empire in 876 B.C. The dynasty founded by Arbaces lasted till its overthrow by Cyrus, 559 B.C.

Ar'balest. See CROSS-BOW.

Arbe'la, now **Arbeel**, a small town in Asiatic Turkey which gave its name to a decisive battle fought by Alexander the Great against Darius at Gaugamela, about 20 miles distant from it, 1 Oct. 331 B.C. There are several large mosques in the modern town. Pop. about 6,000.

Ar'ber, Edward, an English scholar, emeritus professor of English literature at Mason College, Birmingham. He is best known through the excellent reprints of which he is editor. These include 'English Reprints' (1868–71); 'Tyndale's New Testament of 1525' (1871); 'A Transcript of the Registers of the Company of the Stationers at London' (1875); 'An English Garner' (1877–96); 'An English Scholar's Library' (1878–84); 'The First Three English Books on America' (1885); 'The Story of the Pilgrim Fathers, 1606-23' (1897); 'British Anthologies' (1899–1900).

Ar'bitra'tion, a term applied to an adjudication by persons, called arbitrators, appointed to decide a matter or matters in controversy by agreement of the disputants. Submissions to arbitration, however, should not be oral, because open to disputes, and in California and Louisiana the submission must be in writing. 2 Cal. 92; 5 La. 133. Also in New York, Code Civ. Pro. 2366. A submission to arbitration may be made at any time of causes not in court, and at common law, where a cause was pending, submission might be made by rule of court before the trial, or by order after it had commenced, which was afterward made a rule of court. It differs from a reference made by the order of a court of law. The proceeding generally is called a submission to arbitration; the parties appointed to decide are termed arbitrators, not referees; and their adjudication is called an award. This mode of settling disputes has been approved by legislatures at various times, and there are statutes in a number of States regulating the proceeding.

Legal Arbitration. — Infants and others not entitled to sue cannot submit controversies to arbitration. In general, where the owner of real estate is incapacitated in any way, and also in many cases of agency, the person having the legal control of the property may submit the matter in dispute to arbitration. Such, for example, as a husband for his wife; a parent or guardian for an infant (not, however, a guardian appointed for some other special purpose); a trustee for his beneficiary; in some instances, an attorney for his client; an agent duly authorized so to do by his principal; an executor or administrator may submit to arbitration, but does so at his personal risk should his estate be improperly held liable.

The matters that may be submitted to an arbitrator are all personal disputes and differences that might otherwise be made the subject of controversy in the courts of civil jurisdiction. The New York Code of Civil Procedure, § 2365, provides that a submission of a controversy to arbitration cannot be made (1) where one of the parties is an infant, or a person incompetent to manage his affairs by reason of lunacy, idiocy, or habitual drunkenness; (2) where the controversy arises respecting a claim to an estate in real property in fee or for life. The second subdivision of this section does not prevent the submission of a claim to an estate for years, or other interest for a term of years, or for one year or less in real property; or of a controversy respecting the partition of real property between joint tenants or tenants in common; or of a controversy respecting the boundaries of lands or the admeasurement of dower. Subject to the exceptions in this section, any controversy existing between two or more persons at the time of the submission may be submitted to arbitration. Thus breaches of contract generally, breaches of promise of marriage, trespass, assaults, charges of slander, differences respecting partnership transactions, or the purchase price of a piece of personal property, all may be referred to arbitration. Differences between landlord and tenant, where no claim of title is interposed, and pure questions of law, may also be referred to the decision of an arbitrator. Actions at law and suits in equity may be settled by arbitration; and this kind of reference may be made at any stage of the proceedings, sometimes even after the verdict, and probably, by analogy, after decree in equity. An agreement to refer future disputes will not be enforced by a decree of specific performance, nor will an action lie for refusing to appoint an arbitrator in accordance with such an agreement. (2 Bos. & P. 235; 6 Ves. Ch. 815; 15 Ga. 473; 50 N. Y. 250; 39 N. Y. 377; 35 Barb. N. Y. 602; 6 State Rep. 603.) It is well settled by authority that an agreement to refer all matters of difference or dispute that may arise to arbitration will not deprive a court of law or equity of jurisdiction. The best reason for the rule is an aversion of the courts, from reasons of public policy, to sanction contracts by which the protection which the law affords individual citizens is renounced. (50 N. Y. 250; 39 N. Y. 377.) A matter clearly illegal cannot be made the subject of a valid submission. But where transactions between parties have been brought to a close by general award, apparently good, the courts have refused to reopen them on a suggestion that some legal item had been admitted in account. It is not the policy of law to refer to arbitration felonies and other criminal offenses of a public nature, because the public safety requires them to be punished, and for this purpose they can be properly tried only in one of the ordinary courts of the country. Partners and corporations may make submission to arbitration. The arbitrator ought to be a person who stands perfectly indifferent between the disputants; but there are no other particular qualifications for the office, and the choice by parties of the person who they agree shall decide between them is perfectly free, unless it is stipulated in the agreement to arbitrate that an arbitrator need not be sworn at common law. In various States of the Union, however, arbitrators are required by statute to take an oath to hear faithfully and fairly, and examine the matters in controversy, and to make a just award according to the best of their understanding, unless the oath is waived by the written consent of the parties to the submission, or their attorneys. (See N. Y. Code Civ. Proc. § 2369.)

In matters of complicated accounts mercantile men are greatly preferred. In other cases it is usual to appoint lawyers, who, being accustomed to judicial investigations, are able to estimate the evidence properly, to confine the examination strictly to the points in question, and, in making the award, to avoid those informalities in respect to which it might afterward be set aside. Both time and expense are thus saved by fixing on a professional arbitrator.

Mode of Procedure.— The proceedings before an arbitrator are regulated generally according to the forms observed in courts of law. The arbitrator on the day appointed hears the case and makes his award, which need not be in writing at common law, for a verbal award is perfectly valid; but in practice it is usual for the arbitrator to make a written award. While at common law the award may be oral or in writing, this rule has been changed by statute in some States, and an award, to be legal in those States, must be in writing. It is provided by the New York Code of Civil Procedure, § 2372, that an award, to be legal, must be in writing. (See AWARD.) This award in its effect operates as a final and conclusive judgment respecting all the matter submitted, and binds the rights of the parties for all time. Arbitrators are allowed the greatest latitude in investigating matters in controversy. They are judges of both law and fact and are not bound by the rules of practice adopted by the courts. (2 Johns. Ch. N. Y. 276, 368; 3 Duer, N. Y. 69; 1 E. D. Smith, N. Y. 85, 265.) Arbitrators cannot delegate their authority; it is a personal trust. (7 Serg. & R. Pa. 228; 2 Atk. Ch. 401.) An award may be set aside on the ground of corruption and fraud in the arbitrator, and for any material irregularity or illegality appearing on the face of the proceedings, such as is beyond or not covered by the submission. The interest of the arbitrator in the subject-matter of controversy, his relationship to one of the parties, business relations between an arbitrator and a party, or the expression of an opinion upon the merits of the controversy, if unknown to the party injured, will warrant the court in holding an arbitrator incompetent to make an award. But the tendency of the courts is to favor arbitration and maintain awards unless such serious grounds as are above referred to can be substantiated. Where there are two arbitrators the submission often provides that in the case of their differing in opinion the matter referred shall be decided by a third person, called an umpire, generally appointed under a power to that effect by the arbitrators themselves. But they cannot make such appointment unless specially authorized so to do by the terms of the submission. This umpire rehears the case, and for this purpose is invested with the same powers as those possessed by the arbitrators, and is bound by the same rules. It remains to be stated in general concerning arbitration that from the nature of the case there can be no appeal, on the merits of the dispute submitted, to any public tribunal whatever. In New York the proceeding to vacate an award, and the grounds on which it can be made, are regulated by statute.

Court of Arbitration.— By chapter 278, laws of 1874, the legislature of New York established the "Court of Arbitration of the Chamber of Commerce of the State of New York," defined its jurisdiction, and regulated its proceedings. Gov. Dix nominated, and the Senate confirmed, the Hon. Enoch L. Fancher as the official arbitrator or judge of the court. Its work was chiefly confined to commercial matters and disputes of shipping merchants, though during its existence almost all subjects of controversy have been before the court and decided. There is no appeal from the decision of the official arbitrator; though, where a defeated party desires it, a rehearing of the case is always granted. No costs or fees to attorneys or counsel can be recovered; each party, whether defeated or not, must bear his own costs and expenses. The London Corporation and the London Chamber of Commerce founded jointly in 1892 a chamber of arbitration, or tribunal of commerce, for settling trade and commercial difficulties; and the great coal dispute and strike of 1893 led to a conference which secured a peaceful conclusion for the time and the foundation of a permanent "Board of Reconciliation," consisting of representatives both of owners and of the miners. Diplomatic conferences, which often obviate war, belong to a different category. The Parliament of New South Wales has passed an act constituting an arbitration tribunal for the purpose of settling industrial disputes. This tribunal consists of a judge of the supreme court, a representative appointed by the employers, and a representative nominated by the employees. The court has jurisdiction in the case of industrial disputes, and a lockout or a strike before allowing time for reference to the court or pending the proceedings of the court is illegal.

International arbitration has been discussed frequently and at length. It has been employed in matters of debate between nations more than a hundred times. As between the United States and Great Britain, the San Juan boundary question, the Alabama question, and the Bering Sea sealing controversy have been so arranged. The first general treaty of arbitration ever drawn between nations was signed 11 Jan. 1897, in Washington, by Richard Olney, secretary of state for the United States, and Sir Julian Pauncefote, ambassador of Great Britain to the United States, for Great Britain. This treaty was placed before the United States Senate, 11 Jan. 1897, accompanied by a special message from President Cleveland, but the Senate refused to ratify it. Since then similar treaties have been made and ratified between Italy and the Argentine Republic and between the Argentine Republic and Uruguay. The International Peace Convention at The Hague, in 1899, established an international court of arbitration which has been ratified by the United States and other signatory powers. See HAGUE COURT.

Arbitration, International. See ARBITRATION.

Arbo'ga, är-bō'ga, a Swedish city, once important commercially, but now only of historical interest from having been at one time a residence of the royal family of Vasa, the scene of Church assemblies and national diets, and for the antiquities in its neighborhood. Pop. (1901) 5,250.

Arboleda, är'bō-lā'tha, **Julio,** a South American poet and statesman: b. in Barbacoas, Colombia, 9 June 1817; d. 1862. He was educated in Europe, and on his return to Colombia engaged in journalism. In the various Colombian revolutions he was a liberal Conservative and more than once declined the vice-presidency of the republic. His poems are much esteemed in Spanish-American literature.

Arbor Day, an annual tree-planting day appointed by nearly every State and Territory of the Union, sometimes as a legal holiday and sometimes merely advisory, to assist in foresting or reforesting scantily wooded tracts, or shading or beautifying towns. It is generally in special connection with the public schools, to impress children with the importance of forestry and natural beauty in our civilization. The date depends on the climate of different sections, and is absolutely fixed in but few; most Northern States hold it in April or early in May; Arizona, Texas, and Alabama in February, the two latter on Washington's birthday; Florida in January, Georgia in December, and New Mexico in March; many make it optional either with the State or with localities, and West Virginia holds it twice a year, in spring and fall. It arose from the alarm felt by the most far-sighted public men over the rapid and reckless deforestation of many parts of the Union, and the prospects of its extending to all, the proof as seen abroad of what that deforestation meant, and the example of their governments in reforesting and conserving. (See FORESTRY.) Most civilized governments at different times have looked after their forests to assure a supply of timber for naval construction; New Hampshire and New York, even in the colonial period, felt it needful to check the inroads on them; the United States government at the beginning of the 19th century bought timber lands, and a quarter of a century later authorized the President to take measures for their preservation; and about the same time the Massachusetts Society for Promoting Agriculture offered prizes for forest planting. But the first widespread realization of its importance was caused in 1864 by the notable book of George P. Marsh (q.v.), the eminent American scholar and diplomat, entitled 'Man and Nature'; the chapter on "The Woods" aroused especial attention, and in 1865 Birdsey G. Northrop, then secretary of the Connecticut Board of Education, suggested that States might profitably plant trees every year at the proper time, or supervise their planting. The subject brought out several books and many articles; the late Dr. Franklin B. Hough, the first forest commissioner, publishing a work upon it as early as 1873. But the first to propose a regular Arbor Day for the purpose was J. Sterling Morton, late commissioner of agriculture, then of Nebraska, who in 1872 succeeded in inducing his almost treeless State to set apart a day for the purpose. Great enthusiasm was aroused, and over a million trees were planted that year. In 1885 it was made a legal State holiday on 22 April, Mr. Morton's birthday. The movement did not at first spread very rapidly, though some localities took it up; the first States to copy the legal enactment were Kansas and Tennessee in 1875, and the next year Minnesota. It was six years before another joined, Ohio in 1882, followed by West Virginia in 1883; then the tide began to rush in, and within five years 26 more States and Territories had adopted the observance. The only absentees now are Delaware, Utah, and Indian Territory, and even there it is observed in some places. ('Arbor Day,' bulletin of the Department of Agriculture.)

Ar'bore'tum (Latin *arbor,* a tree), a place set apart for the cultivation of different trees and shrubs for scientific or educational purposes. See BOTANIC GARDENS; FORESTRY.

Ar'boriculture. See FORESTRY.

Ar'bor Vi'tæ (Latin, "tree of life"), the designation of several trees belonging to the natural order *Coniferæ,* and allied to the cypress. The genus consists of evergreen trees and shrubs, with flattened branchlets, and small, imbricated or scale-like leaves. The common arbor vitæ (*Thuja occidentalis*) is a native of North America, and reaches a height of 50 feet in favorable locations. The cones are small; the young twigs have an agreeable balsamic smell; the wood is soft and light, but tough and durable. There are 60 North American species, the principal one after *T. occidentalis* being *T. plicata,* found on the Pacific coast from the region of San Francisco Bay north to Alaska. The Chinese arbor vitæ (*T. orientalis*) is also common in Great Britain. Its upright branches and larger cones easily distinguish it from the former. It yields a resin which was formerly thought to have medicinal virtues, like the wood and young twigs of the *T. occidentalis;* hence the name — arbor vitæ.

Arbutus, är'bū-tŭs or är-bū'tŭs, the designation of a genus of about 20 species of shrubs, mostly evergreen and small trees of the natural order *Ericaceæ,* natives mainly of Europe and North America. The species, many of which have smooth red branches, are often used for ornamental purposes, the smaller species in greenhouses as well as in the parks of warm temperate climates. *A. unedo,* the strawberry tree, a species from southern Europe, is often planted in California, its profusion of white or rosy flowers and strawberry colored fruits which ripen during the blossoming period of the following year being greatly admired. In Spain this fruit is used to make sugar and a kind of liquor. *A. menziesii,* the madroña, a native of the Pacific Coast States, attains a height of about 100 feet and is the hardiest and perhaps the handsomest species of the genus. *A. arizonicus,* another American species, which sometimes reaches a height of 50 feet, has white bark on the trunk, red branches, pale-green leaves, loose panicles of white flowers, and dark orange-red fruits.

Arbutus, Trailing, an evergreen creeping plant (*Epigæa repens*) of the natural order *Ericaceæ,* growing in shaded sandy and rocky soils, especially in pine woods, from Newfoundland to Florida and westward to Minnesota. It is known in New England as the Mayflower and in the southern United States as ground laurel, and is everywhere prized for its fragrant rose-colored or white flowers, which appear in early spring. Experiments in its cultivation have generally resulted in failure.

Arc, a geometrical term denoting a portion of the circumference of a circle, often cut off by

two lines which intersect it. The name is also applied to a portion of any other curve. The magnitude of an arc of a circle is stated in degrees, minutes, and seconds, which are equal to those of the angle which it subtends at the centre. Hence, counted by degrees, minutes, and seconds, the arc of elevation and the angle of elevation of a heavenly body are the same, and the two terms may be used in most cases indifferently. The straight line uniting the two extremities of an arc is called its chord. Equal arcs must come from circles of equal magnitude, and each must contain the same number of degrees, minutes, and seconds as the others. Similar arcs must also each have the same number of degrees, minutes, and seconds, but they belong to circles of unequal magnitude. Concentric arcs are arcs having the same centre. In mathematical geography, an arc of the earth's meridian, or a meridional arc, is an arc partly measured on the surface of the earth from north to south, partly calculated by trigonometry. By these measurements the earth was discovered to be an oblate spheroid.

Arc, Electric. See ELECTRIC LIGHT.

Arc, Joan of. See JOAN OF ARC.

Ar'ca, a term applied to a genus of conchiferous mollusks, the typical one of the family *Arcadæ*. The shell is strongly ribbed or cancellated, hinge straight, with very numerous transverse teeth. They are universally distributed, but are commonest in warm seas. They inhabit the zone from low water to 230 fathoms. The fossil species are found in the United States, Europe, and southern India.

Arcadius, the first emperor of the East: b. 377; d. 408. He was son of the Emperor Theodosius, on whose death in 395 the empire was divided, he obtaining the East, and his brother Honorius the West. He proved unable to govern for himself, and was a mere tool, first in the hands of Rufinus, then of the eunuch Eutropius, and then of his queen Eudoxia.

Arc de Triomphe du Carrousel, ärk dė tre'ônf dü ka'roo'zĕl. See ARCH, MEMORIAL AND TRIUMPHAL.

Arc de Triomphe de l'Etoile, ärk dė tre' ônf dü la'twäl. See ARCH, MEMORIAL AND TRIUMPHAL.

Arcesilaus, a Greek philosopher: b. 316 B.C.; d. 241 B.C. He studied philosophy at Athens and was largely influenced by Crates and Crantor. At the latter's death he became the head of the Academic School. Arcesilaus denied the certainty of intellectual and sensuous knowledge and recommended abstinence from all dogmatic judgments.

Arch, an architectural term denoting a structural form made up of a series of wedge-shaped stones, or bricks, so arranged over a door or window in an edifice for habitation, or between the piers of a bridge, as to support each other, and to carry in addition the weight of the superstructure. These stones and bricks, of a truncated wedge shape, used in building arches, are called voussoirs. The side of an arch between the crown and the springer, or skewback, is called its haunch or flank, and by old English writers of the 16th century, its hanse. The highest part of the arch is called its crown, or by the old English authors, the scheme or skeen, from the Italian *schiéna,* the back. The lowest voussoirs of an arch are called springers, or skewbacks, and the central one, the keystone. The under or concave side of the voussoirs is called the intrados, and the outer or convex one the extrados of the arch. A chord of the arch at its lower part is called its span, and a line drawn at right angles to this chord, and extending upward to the under side of the keystone, is called its rise. The impost of an arch is the portion of the pier or abutment whence the arch springs; the thrust of the arch is its outward pressure against the abutments. The voussoirs are also called ring-stones. The spandrel is the part above the haunches, or, in a bridge, the part between the arch-ring and the roadway. If the height of the crown of an arch above the level of its impost be greater than half the span of the arch, the arch is said to be surmounted. If, on the contrary, it be less, the arch is said to be surbased. The curved arch was known to the Assyrians and the old Egyptians. Sir J. G. Wilkinson considers that it existed in brick in the reign of Amenoph I., about 1540 B.C., and in stone in the time of Psammetichus II., 600 B.C. The evidence is derived from the ruins of actual buildings, but paintings appear to carry the arch back to about 2020 B.C. There is no mention of the genuine arch in Scripture, the term "arches," in Ezek. xl. 16, being a mistranslation. The round arch was brought into extensive use by the Romans, and prevailed everywhere until the 12th century A.D., when the arch pointed at the apex, and called in consequence the pointed arch — the one so frequently seen in Gothic architecture — appeared in Europe as its rival. The forms of both curved and pointed arches may be varied indefinitely. Of the former may be mentioned the horseshoe arch, a name which explains itself, and the foil arch, from Latin *folium,* a leaf, of which there are the trefoil, the cinquefoil, and the multifoil varieties, so named from the plant-forms after which they are modeled. Other arches are the equilateral, in which the centres of the circles whose intersection constitutes the pointed arch coincide with the angular points at the two sides of the base; the lancet, in which the centres of the circles fall beyond these points; the drop arch, where they fall within the base; and the segmental arch, the sides of which constitute segments of circles containing less than 180 degrees. Besides these there are several other varieties of arch distinguished by their respective forms. The names applied to arches may be divided into several classes, as referring to geometric or familiar forms, style or position in the building. The following are different geometrical forms: The flat arch, with voussoirs radiating from one centre. Arches with one centre are: semicircular, segmental, horseshoe. Arches with two centres are; the equilateral pointed arch, where the centres of the circles coincide with the angular points at the two sides of the base; the drop arch, where they fall within the base; the lancet, where they fall outside of it, and the pointed horseshoe. The common three-centred arch is called basket-handled arch, this being the form generally used instead of an ellipse. Four-centred, six-centred, and other similar forms are occasionally used. The names horseshoe, lancet, basket-handled, etc., are given because of their resemblance to familiar forms. Gothic, Roman, and Moorish

arches are names given because these forms were used in those architectural styles. Certain names are given with reference to the position of the arch in the building, such as discharging or relieving arch, where the arch is placed over a lintel to carry pressure to the sides.

Examples of arches are the Cloaca Maxima, built about 641 B.C., with three concentric rings of voussoirs, inside diameter, 14 feet; the Pont du Gard, built by Agrippa, 19 B.C., which has semicircular arches, built of Pozzuolani concrete with stone or brick facing. The longest masonry span in Europe is the railway bridge over the Pruth, Jaremcze, Austria, 213 feet wide with a rise of 59 feet, and built in 1892. This shows hollow spandrels, which are constructionally and artistically correct. The Cabin John Bridge, near Washington, D. C., which carries an aqueduct and highway, 220 feet, the largest masonry span in the world. The Wheeling, W. Va., Main Street Bridge, built in 1892, 159 feet long, 28 feet rise, is deceptive, as spandrels are hollow, but appear to be solid. The great arch now built for the Cathedral of St. John the Divine, New York, is of masonry resting on the top of piers 86 feet high. The span is 114 feet from outside to outside of voussoirs. In 1896 was built the first large concrete arch in the United States, 40 feet span, 7 feet rise, all of concrete. This was for a highway bridge. There is also a 60-foot arch of steel-concrete in Franklin Bridge, Forest Park, St. Louis, Mo. "Concrete reinforced" is the name given to the combination of concrete with steel or iron in building. Steel concrete, armored concrete, *béton armé, ciment armé,* are various terms for such construction, now coming into frequent use.

The Melan arch system was developed by Prof. Joseph Melan, using stiff steel ribs or beams embedded in concrete to form the arch ring, following Austrian experiments. Examples of Melan arch are found in Eden Park, Cincinnati, O., 70 feet span; railway bridge over Southern Boulevard, Detroit, Mich.; road bridges over the Passaic, Paterson, N. J.; Kansas Ave., Topeka, Kansas, this being the longest, having five arches, one of 125 feet, two of 110 feet each, two of 97 feet each; Hyde-Park-on-Hudson, for F. W. Vanderbilt, 75 feet span; a foot bridge in park, Stockbridge, Mass., 100 feet span, rise 10 feet, only 9 inches thick at crown; three-hinged arch, Steyr, Hungary, span 137 feet, rise only 9 feet, or one fifteenth of span,

In regard to the cost of arches compared with steel construction, a railway steel girder span 60 feet in length, with solid floor, costs about $1,600. The cost of maintenance and renewals capitalized amounts to about $400, giving total cost of about $2,000, while equivalent masonry arch would cost about $1,800. A concrete arch built in 12 hours, by 65 men, 39 feet span, 6½ feet rise, Switzerland, cost, complete, $600. The Monier method is concrete with wire netting imbedded near the soffit. Arches of long span and slight rise in building construction are being made with the Guastavino system of cohesive construction, which is practically a revival of ancient and mediæval building methods. See also ABUTMENT; ARCH, MEMORIAL; BRIDGE; BUTTRESS; VAULT.

FRANK D. BOURNE,
Architect, Boston, Mass.

Arch, Memorial and Triumphal, a monumental structure erected in honor of some prominent person or memorable event. In the custom of temporarily decorating the gates of cities with garlands and trophies, on the return of a victorious general, we can find the origin of the triumphal arch. These are similar in form whether commemorating a peaceful event or a military triumph. In the time of the Roman republic, temporary arches were erected in honor of triumphant generals. At that period, also, memorial arches or *fornices,* were erected in memory of some individual or to ornament a city, but it was not until the time of the Empire that the triumphal arch, the *arcus,* came into use, to perpetuate the glory of a person who had obtained the honors of a triumph. Arches were often placed at the entrance of cities, becoming in such a position merely a monumental form of city gate. The usual form of triumphal or memorial arch employed a high and imposing semicircular arch as its central motive, resting on heavy piers, which were decorated generally with Corinthian columns and other architectural details, statuary, and bas-reliefs. Above this was a heavy mass of stone-work or attic, on which was placed a suitable inscription. The arch of Titus, at Rome, is the most remarkable for its purity, the beauty of its sculpture, and the harmony of its proportions. It was probably erected by Domitian in honor of Titus to recall his conquest of Jerusalem. In panels on the inner sides of the piers are sculptured, on one side the triumphant Titus on his *quadriga* surrounded by soldiers; on the other side the triumphal procession, with the spoils of the Temple, the sacred vessels and the seven-branched candlestick. At the foot of the Capitol, at the side of the Forum, is the arch of Septimius Severus, erected in honor of this emperor and his two sons to commemorate their victories over the Parthians and the Arabians. It has small side arches reached by a few steps, and a large central arch. The most important arch in Rome is that to Constantine, which is similar to that of Septimius Severus. It was erected by the Senate and the Roman people in honor of Constantine. The arch of Trajan at Ancona was erected on a pier which serves as a base, and was a memorial of the completion of that port. It is said that another arch of Trajan at Benevento was erected to commemorate an extension of the Appian Way. In modern times the name triumphal arch is given to a structure of wood or staff decorated with flags, banners, and floral designs, as a part of some public celebration, or in honor of some person; for example, the Dewey arch, in New York. This is an outgrowth of the old Roman idea. Modern history has illustrations of many examples of this form of arch. Albert Dürer has many engravings of the triumphal entry of the Emperor Maximilian, and of the arches erected in his honor. There are also illustrations of arches for Charles V. at Boulogne; to Henry III., at Lido, on his trip to Venice. Rubens made the designs for the triumphal arch for Ferdinand of Austria at Antwerp, and a large arch was erected to Louis XIV. at the Barrière du Trône. There are also triumphal arches in Paris: the Arc du Carrousel near the Louvre, built by Napoleon I., now destroyed; Porte St. Denis, built by Louis XIV.; the large Arc de l'Étoile, dedicated by Napo-

leon to his soldiers and sailors; and Porte St. Martin (1674); in Berlin the Brandenburgerthor at the entrance of the Thiergarten. In the United States there are arches of this character in Brooklyn and Hartford, Conn., and the Washington arch, in New York.

Among celebrated arches of this character, mediæval and modern, may be named the following gateways: At Naples, the Arch of Alfonso of Aragon (1470), and the Porta Capuana; at Burgos, the Santa Maria; at Montpellier, a 17th century memorial of the revocation of the Edict of Nantes; at Milan, Della Pace; at Munich, Sieges Thor (Victory Gate) (1850); and at London, the Marble Arch. See ARCH; GATEWAY.

Bibliography.— Bartoli, P. S. 'Veteres Arcvs Avgvstorvm Trivmphis Insignes ex Reliqviis qvae Romæ adhvc Svpersvnt.' 46 pls. (Romæ, 1824); Beauvais, C. T. 'Monumens des Victoires et Conquêtes des Francais.' (1822); Kinch, 'L'Arc de Triomphe de Salonique' (1890); Knight, W. 'The Arch of Titus, and the Spoils of the Temple' (1867); Normand, L. M. 'Arc de Triomphe des Tuileries Érigé en 1806, d'après les Dessins de MM. C. Percier et P. F. L. Fontaine' (1830); Piccioni, M. 'Sculpture of the Arch of Constantine and Trajan's Column' Romæ, n. d.; Reina, J. 'Description of the Arch of Peace in Milan (Milan, 1839); Reinach, S. 'L'Arc de Titus' (1800); Reland, 'De Spoliis Temple Hierosolymitani in Arcu Titans'; Rossini, L. 'Gli Archi Trionfali, Onorarii e Tunebri degli Antichi Romani Sparsi per Tutta Italia' (1836).

Archæan (är-kē'ăn) **Period,** a term applied to the most ancient division of the geological time-scale. The rocks referred to this period underlie the oldest sedimentary and fossiliferous strata and hence are often called the fundamental complex. They are entirely of crystalline character, consisting of granite and basic eruptives, gneisses, and schists, all of which bear evidence of having undergone great disturbance and metamorphism, so that it is impossible to work out any order of strategraphic succession that will apply to different regions. Their great uniformity of composition over wide areas, their marked characteristics which differentiate them from all other groups of rocks, and their basal position in the geological scale have led many geologists to believe that the Archæan rocks represent a portion of the original crust of the earth as it solidified from molten magma. While this view has not found universal acceptance, it is quite certain that if the first solidification of the earth is still preserved anywhere, it is present in this formation. The Archæan rocks are known to occur in all of the continents, although in some regions they have been brought to the surface only after long periods of erosion during which immense thicknesses of overlying strata were removed. In North America they cover much of the region between the Arctic Ocean and the Great Lakes, and are also found in the Adirondacks, along the Appalachians, and in the Rocky Mountains. They occur in many parts of Europe, especially in Scandinavia, France, Germany, and Austria, in eastern Asia, and in central Africa. See GEOLOGY.

Archæological (är-ke-ō-lŏj'ĭ-kăl) **Institute of America,** a society formed in 1879 for the purpose of promoting and directing archæological investigation and research. Under its direction several important excavations were conducted on the site of the ancient city of Assos. It publishes a bi-monthly 'Journal,' which is its official organ. It has a membership of 1,050. President, Prof. John Williams White of Harvard.

Archæology, är'ke-ŏl'ō-jĭ ("antiquity-study"), the history of antique human progress as inferred from relics of man's industry or presence, apart from written records. It is thus identical with history where there are no such records, and supplementary material for it when they exist. It is distinguished from anthropology as concerned chiefly with industrial and artistic rather than social and political progress. But its limit neither of date nor of subject can be sharply fixed. The antiquities of a country are relative to its present and its records; 400 years in Mexico brings us to pure archæology, 2,000 in Greece and Rome is almost this side of it, all west-Asian history belongs to it. Even written records, if inscriptions on stone or brick, or papyri, are archæological when pertaining to an extinct civilization; if classical, they are history, epigraphy, or palæography. Nor can we wholly dissociate the biological study of the bones found in a prehistoric camp, river drift, or cave (palæontology), from that of the flints, worked bones, drawings, etc., found with them, as evidences of mechanical and intellectual progress (archæology), and the social organism implied by the camps, food, ruddle, etc. (anthropology). The genesis of the science restricted the name at first to remains of classical art and architecture, still often regarded as its most important section, through its illumination of classic literature: but general archæology does not merely supplement a developed history, it reveals the very existence of empires, nations, races, cultures, stages of human progress, otherwise unsuspected, and carries our knowledge far into the geological past.

The classical branch, whose material was relatively accessible and its bearing obvious, naturally originated first in the 18th century; general archæology is the creation wholly of the 19th century and has two independent origins. On one side it springs from the decipherment of the Egyptian hieroglyphs, unveiling a remote history implying a still more remote one, and making scholars realize for the first time how futile were the distorted scraps of classical tradition. This was followed by excavations in Mesopotamia which uncovered the remains of the Assyrian culture, and by the decipherment of the cuneiform characters. Here it was first realized that archæology is the one branch of history (for numismatics is a department of archæology) that absolutely settles historical questions. A written statement may be a falsehood or mistake, but an inscription is conclusive as to its date and writer. On the other side, archæology springs from the examination of relics of antique man in burial mounds, kitchen middens, lake dwellings, caverns, and river drifts, showing his co-existence with animals long extinct and in geologic ages long gone by. These two streams have gradually resulted in a vast storehouse of verified knowledge, not only

unsuspected, but revolutionary of truths previously supposed axiomatic. Briefly, archæology has shown that civilization is not a sudden mushroom growth of a few dozen centuries, from a single centre and a highly developed group, but a gradual evolution through enormous ages, in all parts of the world, from savagery. In place of the convenient division into "civilized, half-civilized, and barbarous," we have many stages of culture, based on the knowledge of natural forces, the utilizing of natural products by art, and the co-ordination of social groups, in combination almost as endless as the notes of an organ, the same tribe being almost civilized on one side and wholly savage on another. The classification of these grades is somewhat different in archæology and anthropology. The latter, in Lewis H. Morgan's system (which needs much qualification) marks seven stages: the first prior to the use of fire; the second marked by the discovery of fire and of catching fish; the third by the bow and arrow; the fourth by pottery; the fifth by the domestication of animals, or the use of irrigation, polished stone or bronze tools, and the occurrence of adobe or stone architecture; the sixth by the use of iron; the seventh, or true civilization, by phonetic alphabets and written records. Archæology, however, finds it convenient to classify man wholly according to the material and construction of his implements, these having in fact accompanied and determined with great accuracy a corresponding set of changes in industrial arts and even social development. Accordingly it divides human progress into the Eolithic ("Stone-Dawn"), the Palæolithic or Old Stone, the Neolithic or New Stone, the Bronze, and the Iron Ages; a portion of these being still further subdivided.

For vast epochs after the appearance of man upon the earth, no record of his presence exists or can exist except a palæolontological one — his bones. He doubtless wrenched off tree-branches and threw or hammered with stones, like the higher simians, but we cannot prove a broken branch or scratches on a stone to be artificial, or due to man rather than to orang. When, however, a stone is rubbed, or evidently bruised from repeated use, still more when a number of these are found near together, we know that something more than casual use by an animal has produced the result; but it may mark only the utterly unrisen savage, who lives on nuts and fruits and sleeps under any casual tree or bank, and has not thought of improving on nature. The first identifiable stage of real culture is:

The Eolithic Age.— This probably began (probably elsewhere also) in Kent, England, where loose flints lay about or might be easily dug from the chalk. These were very roughly hammered into an edge that would bruise off a stick or into a grip for the hand: so roughly, indeed, that their having received deliberate art at all was long bitterly contested. They are found in river deposits on the top of hills 600 feet above the present stream-beds, which must therefore have been excavated since. Even in this remote antiquity man was no new organism on the earth, and this stage of culture, from the excessive slowness of progress in the early stages, must have lasted for a long period.

The Palæolithic Age succeeded; the forme. till recently was reckoned a part of it. It is now further divided into two chief periods, from the anthropological differences implied, those of the river gravels and of the cave-dwellers; and the latter again into three others, with well-marked stages of culture. More specifically:

1. River gravels up to 200 feet above present beds ("Achuleen"). The remains are massive flints scarcely less rude than the former, but unmistakably worked. They still antedate any permanent dwelling or shelter.

2. Cave-dwellers. Man has now a permanent though not artificial dwelling, and the germ of family life is born. (1) "Mousterien": Flint flakes split off (the first true artificial tool), and massive flints hammered into definite shapes, with others rude like the former. (2) "Solutrien": Flints carefully worked and finely shaped. (3) "Magdalenien": Well-shaped flint tools, plentiful bone-working with them, and drawings on implements and the walls of caves.

All these remains have been found along with fossils of the mammoth, cave-bear, cave-lion, sabre-toothed tiger, and other extinct forms, in ancient river deposits, deep under stalagmitic accumulations in caves, beneath American lava-beds, etc. The age assigned to these deposits by geologists is from 100,000 to 300,000 years. Another clue of the same significance is the circumstance that in Egypt flints are found together, of which the latest, Neolithic, were dug and worked fully 7,000 years ago, and are tinged only a faint brown, while others, Palæolithic, have turned nearly black. The most conservative estimate is 100,000 B.C. for the beginning of the Eolithic period; the Palæolithic has not ended yet, but in the advanced regions it began to be displaced by the Neolithic perhaps 10,000 B.C. Roughly speaking, the Old Stone periods cover a space ten times as long as all those since put together, the latter succeeding each other with relative swiftness, as progress accelerates by its own development. In some respects the 19th century has shown more advance than all the previous half-million years of man's existence. The rate of progress has depended greatly also on the natural advantages offered: the flint mines of the English chalk hills with the early savage perhaps corresponded to the coal- and iron-mines of the present, producing rapid advance in skill and also competition of tribes, the stronger expelling the weaker from the coveted districts. On the other hand, the lack of domesticable animals in America had much to do with its slight progress under barbarism.

The Neolithic Age is the evident beginning of modern life, made possible by improved working tools. The remains of this period are not buried under geologic deposits, but lie on or near the surface. They are no longer merely hammered or chipped, but rubbed or ground to shape, giving a sharper edge and a smoother surface. There is a gradual advance in the best specimens to weapons and tools almost equal to metal, such as lance-heads, arrow-heads, knives, daggers, awls, chisels, and axes of razor-like sharpness, and needle points, serviceable for and accompanied by highly-developed arts and manufactures, agriculture, and navigation, of remarkable magnitude and variety. As timber could now be easily cut, men built large wooden dwellings and rowing galleys. Early in the

period we find immense earthworks both for defense and for burial; later, in the cities, brick architecture and fine engineering. The lake dwellings of central Europe and England belong to this period, and, being built on piles over the water, combined security against wild beast and animals with easy fishing, a fashion that spread widely and no doubt rapidly: indeed, some of them with their Neolithic inhabitants lasted into historic times. From these discoveries it is evident that man not only hunted and fished, but raised grain, vines, fruit, and flax, breeding domestic animals to draw the plow, another immense gain to agriculture; spun and wove; made pottery; and not only ornamented that but his tools as well, shaping them for beauty as well as use, thus showing development of æsthetic taste. Still more important was the social development. The large camps indicate a settled tribal society, the careful selection of material from considerable depths indicates combined labor in mining.

Between this and the Bronze Age there existed in some countries what is called by some archæologists a Copper Age, where native copper was hardened with oxid or arsenic; but as it did not drive out flint tools, but only supplemented them, it is hardly entitled to be called an epoch, and is not accompanied by any identifiable advance in general progress consequent upon it, like the others.

The Bronze Age, however, was an enormous step forward. It was earlier in Assyria than Egypt, probably from the Armenian copper: the former introduced it by 5000 B.C.; the latter not fully till about 3000, and did not use it freely till 1600, only 500 years or so before iron displaced it. And in all countries stone implements were still used in sacrifices to the gods, who did not like new inventions. The hardness of the alloy of copper and tin seems to have been realized before its toughness and the many advantages given by ability to cast it; hence at first the stone tools and implements were simply copied in massive bronze, and were needlessly heavy and limited in pattern. But as its properties became evident the tools were much lightened, and made thin yet stiff with embossed patterns, and various kinds invented which could not have been made in stone, as the sickle, gouge, etc. The axe, or celt, was first made as a plain bronze wedge fastened by a thong, as with stone; then cast with a socket for the helve, an extraordinary gain in efficiency. There were light cups and kettles, knives and chisels, spear- and arrow-heads, swords and daggers, and bronze-bound shields, and a mass of personal fastenings and adornments. Some of these were impossible in stone, as buttons, buckles, and pins, necklets, bracelets, rings, and earrings. A priceless collection of these objects was found at Bologna, Italy, in the shape of the abandoned stock of an ancient bronze founder. The industrial advantage of this newly found hardness, toughness, and variety developed industries and trade immensely; it also made possible for the first time true stone architecture, and engineering of hewn and dressed stone. No small branch of business in stoneless Egypt was the quarrying and transportation of stone for the public works from the southern rockier regions.

The Iron Age is the present (though the 19th century developed what is really a distinct era, the Steel Age, making possible many advances beyond the mere iron), and the most of its course belongs to history. It originated from about 1200 to 1000 B.C.,— that strange period, in seeming the blackest in the calendar of the ancient world, when the old civilization of Mesopotamia had collapsed under the Semitic invaders, Egypt had sunk into decay, and barbarism seemed to have reasserted its reign over both the Eastern and Western world; yet in which lies the birth of perhaps the three greatest factors of human progress in historic times,— the use of iron, the alphabet, and the Hebrew nation. The first is thought to have sprung from Armenia; regarding the second, the Phœnician origin is still valid; the third is a mysterious gift of Arabia.

Babylonia and Assyria.— The civilization of the Mesopotamian plain is not only the oldest in the world so far as known, but the first (unless with the possible exception of Egypt) where men settled in great city communities under an orderly government with a developed religion, practising agriculture by irrigation, erecting adobe buildings, and using a syllabified writing. All modern Western civilization is its direct descendant through Greek and Roman periods, so that in studying it we are studying our own ultimate intellectual and even religious pedigree. Its astronomers gave us the division of the year into months, weeks, and days, the signs of the zodiac, the constellations, the division of the circle into degrees; its art was the foundation on which Greek and Etruscan art was built; its religious names, forms, and traditions are a deep element in the Hebrew, as in its cosmogony and mythology and such forms as the Psalms, and hence enter into Christian thought. Nor are we the only beneficiaries. For some 6,000 years the cuneiform was the business and literary script of the whole civilized world, the one method of writing from the western Mediterranean to India, and probably the origin even of the Chinese, as Mesopotamian civilization was the parent of Chinese civilization.

The physical difficulties and dangers of exploration in this district (once a garden and turned into a desert by Turkish misgovernment, a region without supplies or administrative order, and infested by hordes of dangerous Bedouin), as well as the difficulty of obtaining justice or possession of one's goods from the Turkish authorities after finding them, have kept it far behind that of Egypt in thoroughness; but the results have been not less splendid in additions to our knowledge of the past. The earliest studies — those of J. B. Rich, Indian consul-general at Bagdad, in 1818–20, who collected sculptures and outlined Assyrian art: the excavations by the French consul Botta at Khorsabad in 1843, of Nimrud and Nineveh by Layard in 1845–51, and Hormuzd Rassam in 1854 — were of relatively modern Assyrian sites. The first entrance on the ancient Babylonian civilization was made at Erech (1849–52) by Loftus; a further one by Sarzac in the important Tello excavations of 1876–81; but by far the most important was by the Americans, Peters and Haynes, with Hilprecht, at Nippur from 1889 down. This was probably the first city foundation in the world, dating from about 7000 B.C., then a seaport and now 120 miles inland; and the great temple library has poured

floods of light on the political and social condition of this mother-land of modern culture. Next to this, our greatest source of information — for Babylonian history almost the whole — has been the library of Nabonidus, the last king, at Babylon. The whole fabric of Assyrian chronology rests on his statement that Naram-Sin, the son of Sargon, lived 3,200 years before his time: a suspicious number, the dubiousness of which leaves half that chronology a thousand years or so doubtful. But the subject was practically sealed till the decipherment of the inscriptions gave the key; and this was immensely complicated by the fact that the cuneiform character, like the modern alphabet, did not imply any given language, but was used for all the tongues of the then civilization. The first step was taken in 1800 by Grotefend, who identified Persian names and then applied the characters to other names, till he made out several Persian inscriptions, and Bournouf (1836) and Lassen (1836–44) worked out the rest of the Persian alphabet. But this was only a small part of the enormous Assyrian syllabary of 600 signs. The task was finally accomplished by Sir Henry Rawlinson by means of the great trilingual Behistun (q.v.) inscription, in Assyrian, Median or Vannic, and Persian: his knowledge of old Persian gained from Zend and Sanskrit enabled him to identify the Persian words in Assyrian character, and thus resolve the vast Assyrian syllabary. This has given the clue in turn to the other languages written in the cuneiform: the old Sumerian, Median, etc.

The general results are as follows: The earliest inscriptions show us a mixed people speaking two languages: one certainly Semitic, the other either an archaic Semitic or Aryan (the Ural-Altaic affinity is now discredited). The non-Semitic element, known as Sumerian ("river-men"?) is believed to be Aryan, related to the Caucasian tribes, and to be the original settlers of the valley. Into this valley came, somewhere between 10000 and 8000 B.C., a Semitic invasion (Accadians, = "highlanders"?) from the upper Euphrates-Tigris valleys, and by 5000 B.C. had developed, through the mixture of two powerful stocks, the wonderful civilization we know. The beginnings were in the Neolithic Age, but by 7000 B.C. the people were already organized into nations, and built fortified towns, the centre and heart of each being the temple of the local god, raised on immense piles of brick-work. They had finely colored and ornamented pottery, made with the potter's wheel. The principle of the arch was known as early as 5000 B.C.; the architecture was careful and related to the nature of material; drainage systems were constructed to prevent soaking into the adobe. Several important centres existed by about 7000 B.C., including Nippur, Ur, Eridu, and probably Erech. When we first find inscriptions, perhaps about 4000 B.C., there had already been evolved from the old picture-writing a system of conventionalized line-symbols, some pure pictographs, some ideographs, some syllables; and while at first the writing was entirely votive or commemorative, and stone used as the material with straight lines, it was soon applied to business and record, the ever-present clay utilized, and the lines assumed the familiar wedge or cuneiform shape. Sculpture and the engraving of gems and gold were already at a high level shortly after 4000.

The history will be found under Assyria and Babylonia. The great landmarks are the reign of Sargon, the Charlemagne of the ancient world, who founded a huge west-Asiatic "empire" from north Arabia to Armenia and west to the Mediterranean; the second great Semitic invasion from Arabia about 2500 B.C., overrunning south Babylonia, and the Elamite invasion from the Karun valley in Persia about 2300 B.C., subjugating the remainder; the expulsion of the Elamites about 2250 by Hammurabi ("Amraphel"), and the founding of Babylon, which became for 17 centuries the Rome of the Asiatic world, the political and religious centre at once; the first emergence of Assyria, on the Accadian highlands, about 1800; the Kassite invasion from the Persian highlands 1782 B.C., founding a dynasty which ruled Babylonia till 1207; their expulsion; the great double invasion of Semites from the south and Aryans from the north, which broke up the Hittite empire and overwhelmed Babylonia and Assyria in a common wreck; the collapse of the Old World civilization; the re-emergence of Assyria and its domination over Babylonia, from about 900; its eclipse by the growth of Armenia in the 8th century; its new and enormous power under Tiglath-Pileser II., who annexes Babylonia; the destruction of Babylon by Sennacherib, 689 B.C., and its rebuilding by his son Esarhaddon; the rebirth of Babylonia under Nabopolassar the Chaldæan, who extinguished Assyria, 610 or 609 B.C., and, after a short, brilliant career, the end of the Babylonian-Assyrian power forever through its conquest by Cyrus. The relation of the Assyrian power to the Babylonian was much like that of Rome to Greece; though on a lower scale, for the Assyrians, though great warriors, had none of the organizing and assimilating power of Rome. Assyria copied laboriously, and on the whole clumsily, the literature and art of its intellectual masters, and produced no literature proper of its own. But its libraries, copied from the Babylonian tablets with minute textual and critical accuracy, give it an imperishable claim to our gratitude.

Egypt.— The archæological history of prehistoric civilizations was studied in Egypt earlier, and has been studied there more fully, than elsewhere, from the accessibility of relics and safety of work, the involution of Egyptian politics and history with records in a classic language through the existence of an Egyptian state under classic rulers, and the survival of a descendant of the Egyptian language to our own day. It was the latter which furnished the key to the decipherment of the hieroglyphic records. The Rosetta Stone (q.v.), discovered by the French in 1799, bearing a proclamation in hieroglyphic, demotic, and Greek, invited a textual comparison. An Englishman, Young, devised a correct principle, but had neither knowledge nor interest to apply it in full; Sir William Gell utilized his knowledge of Coptic, and identified three fourths of the signs; Champollion, the Frenchman, was a thorough Coptic student, and in 1821–32 worked out the entire system for use. This first made it possible to rescue Egyptian history in preclassic times from the fog of distorted Greek legends, scraps of priestly record, and misapplied Biblical compari-

sons, while the excavations at Thebes in 1820–30 opened up the Ramesside and neighboring periods 1500–1000 B.C. Later, Lepsius and Mariette were foremost in revealing the period of the Pyramid-Builders, carrying us back to far past 3000 B.C.; and still later Dr. Flinders Petrie has not only turned the First Dynasty and others still farther back, from myth into solid history, but has recreated the prehistoric world prior to the organization of the monarchy, about 4800 B.C., with a surety as great as that of written record. In the historic periods, the total lack of any chronological sense in the Egyptians, who in this respect were very different from the Assyrians, and the catastrophe of the Hyksos invasion, make its history in large portions less clear than the Babylonian; but we know its general outline at worst, and the synchronism and variations of arts and industries often supply the lack of dated chronology.

The oldest inhabitants of upper Egypt known were of the same race as the Algerian Kabyles of to-day,— a white-skinned, blond, blue-eyed, narrow-headed race, with a negro strain, allied to the south European races. They had acquired by 5000 B.C. the highest grade of Neolithic civilization ever reached in the world, so far as evidenced by tools and implements,— the finish of the flint-knives and lances being incomparable,— and were using copper ones also. They built brick towns, and carried on an active Mediterranean commerce in large rowed galleys; they made leather and woven linen clothes, beautiful and varied pottery without the wheel, perfect vases of the hardest stone without the lathe, applied colored glazes even to great rock carvings, manufactured ornaments of precious stones, metals, and ivory, ivory spoons and combs, games, etc. Their art, however, was very crude, and they had no system of writing whatever, though using marks. About 5000 B.C. a much more developed race invaded Egypt,— probably from Arabia, whence the Hyksos and the Hebrews and the other Semites came: a race which used metals more freely, had a system of writing, a better government organization, and higher artistic taste. Here, as in Assyria, the blending of two able but diverse strains made the great Egyptian type and civilization of the Old Kingdom, which we know from their monuments and achievements. They were a grand people in every way: active warriors and administrators, firm in policy, fine mechanicians, adepts in organizing combined labor; strong artists, with lofty conceptions; withal a sensitive, kindly, sympathetic folk, with the least strain of ferocious savagery of any great people in history. This long era has left us the Pyramids and magnificent monumental tombs, masses of grand and accurate architecture, and noble sculpture. This great age could not last forever, and for some centuries after about 2500 B.C. it was in decline, to revive only less brilliantly in the Twelfth Dynasty about 2000 B.C., considered by Egyptian writers their Golden Age of art and literature. The tremendous catastrophe of the Hyksos invasion, already mentioned, took place probably about 1780 B.C., and the «Shepherd Kings» remained till about 1600. Their final expulsion opened a new and brilliant era, of expansion into and domination over west Asia, of the closest relations with the Mediterranean countries, of a general spread of luxury through the people Egypt for the first time threw off its exclusion and became part of the current of the world's progress. In this period (about 1600–1200) we find, near the beginning, the great Thothmes III., whose exploits were exaggerated into the Sesostris of Greek tradition; near the end the rather braggart King Rameses II., commonly identified with Joseph's Pharaoh, and his son Merneptah, often accredited as the Pharaoh of the Exodus. But the empire had the doom of all states which live on the tribute of foreign districts: the outside revenue stopped, the habits of luxury remained, and the nation declined. In the thousand years to follow before it was absorbed in Rome, it had much prosperity and some periods of brief glory, but the vital spirit had gone.

Syria.— While the work of the Palestine Exploration Fund, from 1866 onward, has thoroughly mapped out the surface of the country, relatively little has been done in excavation here or in Turkey; for political reasons (as before noted) mainly, as the interest in Biblical sites and classical remains is the keenest of all. The chief part thus far has been at Jerusalem and the Philistine cities, and in the north at Zinjirli; but few inscriptions have been found even where the excavation has been done, and no very ancient ones. The most important historically is that of Mesha, king of Moab (? 896 B.C.). It would seem that by the time the Jewish nation was advanced enough to make inscriptions, its intellectual activity was drawn off in other directions, and the hope of finding masses of archæological confirmation of or supplement to Biblical records has been disappointed. The chief historical result of Syrian research has been to restore the Hittite empire (q.v.) to history: formerly regarded as a Canaanitish tribe, it is now known to have been a powerful people from Cappadocia, which formed for a couple of centuries a strong state ruling north Syria and much of Asia Minor, with its centre at Carchemish, till broken up by the great southward Aryan movement of which the Dorian invasion was a part. Its writing is almost undeciphered. Curiously enough, the most important documents for ancient Syrian history have been found not in Syria, but in Egypt,— the Tel-el-Amarna tablets, containing a 15th century correspondence with Egypt in cuneiform.

Classical Archæology.— Till the very recent excavations at Troy, Mycenæ, etc., resulting from enthusiasm for the Homeric poems, archæological research in the classic lands was mostly confined to illustrating historical periods, and to a study of Greek and Roman art and architecture; even now the light on prehistoric times is not from written records and inscriptions as in the East, but inferential from material objects. It has, however, in confirmation of Egyptian and other records, and by comparison of objects with those of known date in that country and Babylonia, given unmistakable proof of a hitherto unsuspected stratum of old Greek history. From foreign pottery found in Egypt, 5000–3000 B.C., Greece and Italy probably had a Neolithic pottery-making population at those times. But the first positive beginning of civilized settlement is in the lowest Troy, dating certainly before 2000 B.C., and perhaps 3000: almost no metal is found there. Still before 2000 is another Troy,

with fine vases and golden ornaments. This was contemporary with the supremacy of Crete, then the mistress of the seas, as the Etruscans and Phœnicians were later; and there was a direct connection between Crete and Troy. The legends of the great law-making Cretan kings and their suzerainty over Greece and exactions of tribute from it are doubtless based on fact; even the Labyrinth has been uncovered, and a nucleus of fact in much of the old Greek legendary lore made probable. Three times after this was Troy abandoned and rebuilt before the contemporary of the Mycenæan kingdom of about 1500 B.C. is reached. At this time the coasts of Greece and the Ægean islands were the seat of a high culture radiating in all directions, and even influencing the East, so that this has been styled the "Ægean Period" of civilization. There was a powerful and wealthy kingdom with its centre at Mycenæ, where we find magnificent domed tombs, fine jewelry and metal work, exquisite pottery and ornaments, etc.; as also at other great towns marked by hill fortresses, Athens, Tiryns, and other places. This rich and prosperous land traded with all the Mediterranean countries, but chiefly with Egypt, in whose ruins are found hosts of Greek objects of this period. By 1100 B.C. this civilization had begun to droop, and about 1000 the invasion of the barbarous Dorians from the north temporarily overwhelmed it on the mainland. But it was only for a time: even where the Dorians had conquered, the union of old and new flowered into richer bloom, and Athens, the chief city which they had not conquered, became the head and heart of a far more splendid revival of every art and literature, the foremost in the world to the present time. By the 7th century the immortals had begun to spring up: Archilochus and Sappho were islanders, and the great time of Athens had not yet come, but the thronging masters show that society had become fairly settled once more.

The development of civilization was very much later in Italy than in Greece, and more slowly affected by outside civilizations except on the southern coast. The Neolithic Age, with black pottery and lake dwellings, lasted down to nearly or quite 1000 B.C., the full development of the Bronze Age not taking place till about 800. The Etruscan invasion, which tradition brings from Asia Minor, cannot be dated, but was probably later than 1000 B.C. The art and religion of the Etruscans were entirely foreign, indicating rather a Northern than an Eastern origin; but they were not an original people, and borrowed elements of civilization and art from every nation they came in contact with.— Italians, Greeks, Egyptians, and Assyrians. In this assimilativeness they remind one of the Northmen, and the tradition of their origin may be wholly wrong. The one great specialty of the Etruscans was engineering. Their history and affiliations remain a mystery chiefly because their language is such. Known since historic times, and in the last century thousands of inscriptions in it copied, and even many words translated for us, the language remains an absolute secret to the laborious and penetrating scholarship directed on it.

Archæology, American. America's place in the world's history has been an abundant source of discussion among geologists and archæologists, and there exists still a wide range of opinion, particularly concerning the antiquity of man on this continent. There is uniformity of opinion as to the occurrence in definite superficial strata of traces of man's handiwork, but the geological history of these strata has been variously considered. It is now generally concluded, however, that they are a product of the concluding activities of the Glacial Epoch, material laid down by floods caused by the melting of the glaciers that filled the valleys, and not improbably accompanied by rainfall far in excess of any in post-glacial times.

As yet the evidences of man's antiquity may be summed up in the discoveries made in the valley of the Delaware River (1872–1902) on the Atlantic slope, and the shell-heap discoveries (Dall) on the Pacific slope. In the interior of the continent there have been many reported discoveries of evidences of equal antiquity, but so generally were they open to possible errors of observation, due to lack of skill required in such investigations, that their acceptance has not been general. This is true even of the much-discussed Calaveras skull and Nampa image. This, however, is not true of the human cranium known as the "Lansing skull," from Kansas, and the age of the deposit in which it was found only is in dispute. Much more satisfactory is the result before mentioned obtained by Dall in his investigation of the Pacific coast shell-heaps. Here we have evidence of a gradual change of habit, of a succession of occupations of the region that enables us to deal with "time relative" if not "time absolute," and to feel assured that man's first appearance on the western coast of North America was in the extremely long distant past as measured by years. As shown that traces of man occur in deposits on the Atlantic coast, notably in the valley of the Delaware River, the dual question arises just when and whence came man to the American continent? It is inherently improbable that he did so while glacial conditions obtained in the northern half of the country, for in that case he would have confined himself to those unglaciated regions in the south, where the struggle for existence was reduced to its minimum. It is far more probable that his arrival on the continent was pre-glacial and that when driven southward by the steady encroachment of the ice-sheet he lingered at its southward limit of extension and lived in a manner not essentially dissimilar to that of the present boreal races, but more favorable in that the fauna was richer than that of the circumpolar regions of to-day. This is not to say that the glacial man of the Delaware valley and the Eskimo of to-day were racially the same, but merely that similar physical conditions would produce essentially the same modes of living.

It can scarcely be questioned that man originally was a tropical animal, and the existence of boreal races indicates that primitive man was slowly differentiated and, spreading over the earth, so far changed in habit as the environment required. Pre-glacial man — at least in North America — is yet to be demonstrated by unquestionable discoveries of his remains, but theoretically nothing can be more reasonable than the claim of his one-time existence.

From what other continent man came to America is still an unsettled question. The

necessity for an ultra-American origin is insisted upon, perhaps illogically, but, accepting the necessity, a migration route is fancied from the direction of Japan or directly across Bering's Strait from Siberia, and that North America was peopled by an incursion of wandering humanity into the northwest portion of the continent, and thence followed down the Pacific coast and finally spread eastwardly until the Atlantic checked the movement. That the Japanese archipelago was the «home» of the first American is possible, so far as our present knowledge warrants our forming any opinion on this point; but, accepting this or another Asiatic origin of this country's «first» people, it is clearly evident, from the traces of them that have been recovered, that the trans-Pacific migration occurred in what we know as pre-glacial time, and so, so far in the past that race-differentiation had not progressed to an extent at all comparable to what has since occurred. The pioneer invaders of the American continent were doubtless much the same as folk wherever found at that time; in other words, still very near to that primitive condition in which man remained so long after losing all visible traces of its pithecoid ancestry. If such was his condition, man might well have wandered over a wide territory, tracing each river's valley, up or down, as the case might be, and, depending upon his physical strength and the simplest of weapons, it is little wonder that no recognizable traces of him should be found. His inventive ingenuity was subsequently developed, and it is in tracing this from its humblest manifestations to the degree of skill in tool-making ultimately acquired, that the archæologist is able to demonstrate that man in the lowest state of savagery originally peopled this continent, and that there has been here a growth or development of human faculties which may be considered strictly indigenous. This advance toward what we call «civilization» reached its highest point in Mexico, in Central America, and in Peru. That it was influenced in Mexico and Central America, if not elsewhere, by an occasional influx of Asiatic people who had outreached their distant cousins, is persistently claimed; and certainly, if at a far more remote period an Asiatic savage had reached this country, it is not improbable that such an occurrence should happen in later time, when savagery had given way to a higher cult and travel by land and water was a less formidable undertaking. Such influence may have been impressed at times upon the growing American civilization, but never to such a degree as radically to change its character. The American race was too firmly fixed to be wholly altered, and whatsoever reached it from the East in recent times — geologically speaking — made but an inconsiderable impression.

Dating, then, the appearance of man on this continent at the close of the Glacial Epoch (q.v.), and inferring only that his career really commenced in pre-glacial time, we find him a rude chipper of flint-like stone, fashioning implements so nearly identical with the palæolithic forms of other continents that it is logical to assume that his general mode of living and mental attainments were the same as those of the river-drift man of Europe. This, when the activities of glacial conditions were at their height; but as these waned, slowly a change took place. Faunal changes certainly occurred, and these may have been the direct cause of the alterations in implement forms; for it is at this time that the more specialized and smaller objects, intended for smaller game, appear; among them the arrow-head. These are found in the alternated layers of sand and clay that overlie the coarse gravels due to the torrential floods that marked the beginning of the close of the great Ice Age. These stone implements are almost wholly made of argillite — laminated slates that have been fused by volcanic heat — and are the traces of an intermediate period between palæolithic man proper and the historic Indian.

This intermediate period was one of immensely long duration; one during which the surface was but sparsely clad with vegetation, and tree-growth limited to coniferous forests that had grown for ages beyond the reach of the encroaching glaciers. It was during this time that the bow came into use, and there was a faint foreshadowing of the manifold activities of later date, but as yet no pottery. It was now that the surface soil began accumulating, here and there in favorable spots, and finally until the old half-barren sands were covered. With this change vegetation increased until the flora was what we now find it. Deciduous trees grew where the soil was moist, and at last the country was concealed by forests. It was not until then that the Indian occupation of the country really commenced. As we know him, he is strictly a creature of the soil and not related to any of the older, underlying sands. He is a man of history, and of that misty borderland of history and geology known as prehistoric time. That there was an interim, when the «argillite» man was absent and the flint-chipping, pottery-making Indian finally appeared, has not been demonstrated, but is probable. It has been suggested by Hrdlicka that if the argillite man was in possession of the land when the later Indian arrived, there would be found a modification in skull type resulting from the absorption of one race by another. As yet such crania have not been discovered. This is negative evidence, and it is offset by the fact that skulls have been discovered in undisturbed glacial strata that are of wholly different type from that of the Indian. How far we can be guided by craniology alone has yet to be determined, but taking in this case all conditions under consideration, in the Delaware valley, where exhaustive researches have been made (Volk), there is evidence that can scarcely be disputed that man was here to witness the closing acts of the ice-drama — if not its entire progress — and continued to live in this river valley during the subsequent centuries that bring us to the confines of historic time. What relation he bore to the Indian who succeeded him has yet to be determined. The appearances to-day of the soil and underlying sands, each with its imperishable traces of man, suggest continuous occupation of the region, but do not prove it. However this may be, it does not affect the sequence here given of man's career on the Atlantic slope of North America:

A. Paleolithic Man.
B. Post-paleolithic Man.
C. Historic Indian.

The so-called Indian of this continent has been so closely studied, and his handiwork, whether of stone, bone, metal, or clay, scruti-

nized so exhaustively by ethnologists that everything relating to him is familiar to all. But our knowledge is not as definite and free from contradiction as might be wished. Theories beyond count have been elaborately set forth, each claiming to fix finally the career of these people. The literature of the subject is enormous and stands quite as much a monument to our ignorance as to our erudition. That the Indian is a descendant of the man who reached the continent in pre-glacial time or during an immediately succeeding period is in all probability true. That the variations in his degree of culture and all that he has succeeded in accomplishing is due to his environment on this continent; is an unfolding of his faculties uninfluenced except by Nature,— may be accepted as in all probability true of him; even such advanced outreaching toward our own conception of civilization as was found in Mexico, Central America, and in Peru does not call for the incoming of a superior people. The Indian of North America, in possession when the country was invaded by the European, has been denied any significant antiquity, and not a trace of his labors, whether earthwork, shell-heap, or deeply-buried implement has been admitted to possess an age at all suggestive. All the "mounds" have been declared to be of Cherokee origin, and not one dating so far back that the years may not be easily counted. Here the pendulum swung too far toward the craze for modernity. As well confuse the Aztec and the Eskimo. There are mounds and mounds,— mounds proper, the history of which had faded from the traditions of the Indians; and earthworks that were not beyond the capabilities of the various tribal groups or tribes known to the Jesuit fathers who saw the people to such excellent advantage.

It is to the careful examination of our sea-coast shell-heaps that we must look for those evidences of prolonged occupation of the country which admit practically of no dispute. These accumulations of clam and oyster shells in many localities show that they were begun when the shore level was not what it now is; the base of the heaps being now several feet below the water's surface at low tide. These shell-heaps are to be judged by the traces of handiwork found in them and likewise by a careful study of the shells themselves. The implements and pottery have been found in some instances to be of the rudest description, while in others the traces are of workmanship that was reached only in the palmiest days of Indian time. This might prove a snare to the archæologist if all considerations were not kept in view, for not a one-time village site in the land but shows a curious commingling of crude and elaborate implements, weapons, and ornaments; but it has been found — on the North Atlantic coast, at least — that the shell-heaps that are apparently the older are really such from the fact that argillite implements, and no pottery, are found in them. This significance of argillite unassociated with objects of other material has already been pointed out. But more full of meaning than all else is the fact that the same species of mollusk has gradually undergone a change during the time that elapsed between the laying down of the base of the shell-heap and the day of its final abandonment. Evolution is as slow as it is sure, and the change mentioned is alone sufficient to indicate beyond cavil the antiquity of the sea-coast dweller, who must be considered strictly post-glacial, but impressively prehistoric. An overlooked feature of the subject is that of the marked difference in the traces of man found in different village sites scattered over a limited area, as of 10 or 20 square miles. It has not infrequently happened that traces of human occupation have been brought to light wherein nothing but the rudest forms of implements and coarsest grade of pottery occur. Such have been found, too, remote from present watercourses, deeply buried, and the spot still retaining evidences of being heavily forested after the site was abandoned by man. No one can unearth such evidences of one-time human presence without being impressed with their antiquity as counted by years; but of far greater significance is the occurrence of such a village site finally abandoned, overgrown, and buried by drifting sands, and then, when not a vestige of it remained visible, the spot being reoccupied by an Indian of greater skill in handicraft. Exposing the relics of the two occupations and placing them side by side, the difference is eloquent of the lapse of time beyond the skill of pen to picture.

That a family likeness should be traceable among the native races of the Americas is not remarkable and as yet there has been no sufficiency of evidence to lead us to the conclusion that the so-called "Indians" are referable to diverse origins. The cranial differences are of degree only, and when a number of skulls are brought together, the extremes are united by a series of gradations that stamp them all as one in anatomical essentials. Yet, viewing the vast territory as a whole, we find wide differences among these people, differences which may be explained, however, by the wholly dissimilar environment; this not including the strictly boreal people, though their variations from the typical Indian are not, perhaps, so great as has been asserted. The marked feature of the handiwork of Arctic man is skill in carving ivory and very strikingly etching it in such a manner that frequently the fauna of the region and mode of life of the inhabitants are most cleverly depicted. But considering that bone and ivory take the place of stone so largely, and that there is so much enforced idleness during the long Arctic winter, this artistic taste has been most naturally developed. There must of necessity be some occupation, and the artistic instinct is common to all mankind. Whether or not it flourishes — is a vigorous or a stunted growth — is, again, a matter of environment only. The comparatively few stone implements found in the far North are not noticeably well-fashioned, and the majority of their patterns are to be duplicated in the one-time Indian village sites of the temperate regions.

The purported Indian etchings on slate are not as artistic in any instance as those on ivory made within or near the Arctic circle, and it is possible that all or nearly all of them should be ruled out of court. They usually tell too much, when they pass from series of "tally marks" or merely ornamental zigzag lines, which may or may not have had a significance beyond the fabricator's idea of decoration. The tablets from Iowan mounds and the remarkable Lenâpè

stone (q.v.) from eastern Pennsylvania stand out so prominently among the Indian relics of their respective neighborhoods, and especially the latter, that an unqualified acceptance cannot be accorded them. If they were the culmination of artistic effort on the part of the Indians of the central west and Atlantic seaboard respectively, the question arises where are the pictured tablets of lesser degree of merit. There is too great a difference between the notches, straight or zigzag lines and the thrilling scene of battling with a mastodon that finally is stricken by lightning. If all this ever occurred we have not evidence that any Indian of that day had the skill to tell the story in this manner. The same is true of the Iowan tablets. That the Indian had not knowledge of the mastodon we do not claim, for there is every reason to believe that it became extinct in comparatively recent times; probably not more than 25 centuries ago. The conditions under which its bones have been found and the instances of association of human and elephantine bones show that before this country's "autochthonic hunter, Behemoth melted away."

What the Indian was at the time of the Columbian discovery has a distinct bearing on the archæology of the country he occupied, inasmuch as an agriculturist he was in possession of maize and grew it extensively. This plant had become during that time a product of artificiality or cultivated growth, so modified that but for man's care it would be lost. Whatever the plant from which it originated there is no resemblance to it now. To effect such a change calls for an immense lapse of time. Other products of agricultural skill were as carefully grown and the impression that the results of the chase were the main food supply is not a correct one. The researches of Carr on this subject show how methodical these people were as tillers of the soil and that great suffering followed when their crops failed. The Indians did not come to America as agriculturists; of that we can be very sure, and to pass from the hunter-stage of life to that of cultivator of the ground is not conceivable as a sudden transition; but is intelligible as a slow evolutionary process. This development, in no mean stage as finally reached, shows the upward tendency of the Indians in given areas over what is now the United States, and how much beyond the status gained they would have progressed had not European invasion checked their career is conjectural. Herbert Spencer believes they had reached the full limit of their capabilities, but among such a people as these Indians in the 15th century it is conceivable that superior intellects might appear occasionally and such men would have their following. If such men are philosophers and not fanatics, a distinct gain is the result. When it is considered that people with merely a novel view and usually an absurd one become prominent for a day and have a host of applauders, it is not unreasonable to suppose that among the Algonkins or Iroquois there might have risen those who saw the folly of war and set forth convincingly the manifold blessings of peace; who realized the advantages of agriculture over the difficulties attending hunting and so brought into existence a train of thought that would influence the people who gave them a hearing. Attracted first by the novelty of the suggestion, they would later see the logic of the argument, if such existed, and a distinct gain be made. That their growth toward our civilization would ever have been equal to our own is quite improbable, as these people have been as long upon the earth as any other race and America offers opportunities for intellectual growth equal to Asia or Europe. What does appear is that the upward growth was in existence when the blight of European contact fell upon them. Certainly the savage of ten thousand years ago was far lower in skill, in handicraft, and culture generally than the men who witnessed the landing of the Norsemen. Then, or about that time, a fatal scourge seems to have raged along the Atlantic seaboard and the natives suffered a serious check, the result of which appears to have lowered their status, as smallpox and syphilis, introduced by Europeans later, largely decimated their numbers. The Indians for a time were driven to the dire necessity of daily struggle for bare existence, and many of the better things of which they were capable fell into disuse. So, at least, it seems most rational to explain the fact that these people, when European contact became permanent, were not what they had been. They had not been able wholly to recover from one disaster before another overtook them; the last, Spanish, French, and English invasion, proving as destructive as fire upon the dry prairie.

The accounts of what the Jesuit fathers saw and the records of Kalm, Loskiel, Hæckwelder, and many others, make no mention of many forms of implements, ceremonial objects, and talismans, that are now familiar objects in all considerable collections of Indian antiquities; but the simpler forms, as the grooved axe, the polished celt, the arrow-head, flake-knife, and pottery are not only referred to definitely, but the method of manufacture given in considerable detail. Their hunting and agriculture are made plain, and we know with what tools they sought their game and tilled the soil, and more prominent than all else, the culture of tobacco, and the pipe in which it was burned, figure in the pages of the early travelers. Not less conspicuous as objects were more than one form of wrought stone implements to which no reference is made. It is inconceivable that they were successfully hidden, and we can only conclude that they had passed wholly out of use. Assuming that all the products of the Indian's skill in shaping stone, of which we now know nothing, were wholly in disuse and either intentionally hidden or effectually lost, it is strange that the pioneer explorers should have had so little of the archæological instinct as not to have detected traces of them. Had more interest been taken in the Indian's physical welfare, which was important, and less in his spiritual condition, which needed no repairs, we should not now be groping in darkness as to the origin and antiquity of the original, if not autochthonous American.

With so great an extent of country and such diverse physical and climatic conditions, it is obvious that what were originally one people, should by force of environment become widely differentiated in habits of life, and what are now the almost tropical regions of Arizona, New Mexico, and Southern Colorado have been long peopled with Indians that superficially

differ widely from those of the more northern regions. Their cliff dwellings, rock shelters, and well-built permanent dwellings other than those on the faces of cliffs; their pottery, which they had learned to color; their weaving, basket-making, and skill in stone chipping and polishing, all point to a distinct advance over the more northern nomadic tribes. It is practically demonstrated, in the judgment of those who have most exhaustively explored this southwestern region of the United States, that when the country was first occupied by the ancestors of the present Pueblo Indian, the physical conditions and climate were more favorable for human occupation than at present; a fact that has its significance, for the antiquity of man in America is one that has been long disputed; at least an antiquity at all comparable to that of man in Europe. Wandering along our Atlantic coast and laboriously picking from the accumulated shells that have almost hardened into rock, trifling potsherds or a rude arrow-point; or inland, walking over a newly-ploughed field, we gather a grooved stone axe, a celt, spear-head, arrow-point, skin-scraper or a drill; some one or two or perhaps all of these in the course of a morning, we are enabled at best to picture man in but an humble way and think of him as almost one with the wild beasts of the forest on which he preyed — an erroneous, but common impression — then, transplanted quickly to the vast southwest, note the substantial dwelling and skilful products in many lines, it is, at first, difficult to think that these people are but as branches of the same tree. The contrast is impressive and by just so much is it misleading. Step by step the gradations may be traced and when familiar with the handiwork of early man everywhere in North America, the relationship is quite apparent. The need of foreign influence to produce the differences, impressed here and there and again and again, is not apparent.

Mexico and Central America present problems that are not yet solved. Here we are brought face to face with what may be dignified as a real civilization, and so far as its genesis and continuance have been determined, it is essentially a thing of itself and points to no influences other than those that the country might exert. That a foreign element gained lodgment here and through intellectual superiority gained control over and finally absorbed a pre-occupying people has not been demonstrated. So far as we now know of it, it is not a civilization beyond the reach of a native American race. All that is in it that resembles the culture in other continents is far more likely to be coincidence than a transplantation. That essentially the same ideas in given lines may independently arise is beyond dispute. So much more impressive is all that remains of ancient Mexican centres of population that attention has been called to the subject for more than a century and the literature of the subject is enormous, and not free of the curse of undue haste in reaching a conclusion. The Aztec has not been shown to be other than an American Indian, but one advanced beyond the "hunter stage" and so with a fixed habitation. He dwelt where his forefathers had lived and so a more rational, that is, truthful form of tradition was preserved. They were mechanics and artists. They "made useful implements and weapons and high-grade ornaments and jewels from stones, obsidian, and metal (copper, tin, lead, silver, gold); made paper and dyes and were far advanced in weaving, embroidery and feather-work." (Hrdlicka.) They knew well the properties of clay and so ceramic skill was highly developed. With these accomplishments, it is not to be wondered at, that they were also skilled in architecture and erected not dwellings merely, but temples on an elaborate scale and carved their surfaces in most intricate manner. The advanced artisan is always an aspirant and not satisfied, as he might well be, with the acquirements of reasonable creature comfort; in this instance of the Aztec, he devised an intricate form of government and formulated a religion, polytheistic and including "the cult of the sun, moon, and stars; but with this there was a well-defined belief in a single Supreme Deity." (Hrdlicka.) This Aztecan civilization was not alone in America. The Mayans of Yucatan were equally advanced as architects, as artisans, and with society established on an elaborate and intricate basis. If their records have been read aright, they reach back for some seventy-five or more centuries, and granting this as approximating the truth, and claiming the culture existing as an indigenous growth, the date of man's appearance on the continent is carried so far into the past that we must reckon by centuries and not by years. Pure-blooded Aztecs still survive, but the glory of their culture as it blossomed in pre-conquest times, is a matter of history. How great, how far comparable this civilization was to our own can be judged by the exhaustive studies of Madam Zelia Nuttall, in her work, 'The Fundamental Principles of Old and New World Civilizations' (Peabody Museum Memoirs 1901). There is nothing suggestive of the "Indian" as we know him in all these pages. Astronomy, mathematics, and abstruse philosophical disquisition are dealt with and we find, not unnaturally, that in striving to compass the unknowable, they were led to the most extreme cruelty through that anthropomorphic idea of Deity which universally has proved a curse to mankind. The conclusion reached by Mrs. Nuttall is directly the opposite of what has been held in this article as almost if not quite demonstrable; the home, origin, and growth of what has been revealed by archæological research. She writes: "I can but think that the material I have collected will also lead to a recognition that the role of the Phœnicians, as intermediaries of ancient civilization, was greater than has been supposed, and that it is imperative that future research be devoted to a fresh study and examination of those indications which appear to show that America must have been intermittently colonized by the intermediation of Mediterranean sea-farers."

Southward, when the adjoining continent is reached, we find in the vast plains, forests, and following the wonderful rivers of that region, savages that have not as high a standing as those of the temperate regions of North America. The struggle for existence has been, in the tropics, and is, too keen to give opportunity to a mental growth not directly concerned with the bodily passions and demands. Above all else, the savage must eat, and if the food supply

is to be had without effort, the result is bodily inactivity and mental stultification. If the food required must be struggled for, then the body only is excited to vigor, and food obtained, the body is too fatigued to follow physical exertion by mental. This is the result in the extremes of tropical conditions and it is not surprising that man shows to more advantage as the climate becomes more temperate. Mind and body seem then to have more equal chance and the same unevenness of development is found among South American Indians that originally obtained in North America. The differences are those that the different physical features of the country suggested. As Mexico stands to the country north of it, the favored spot wherein flowered and fruited the native civilization of that continent; so in Peru, we find a people who abandoned the more primitive features of a nomadic life, and establishing cities, organized government, society, gave such attention to art, agriculture, and skill in varied handicraft, that they stood apart, finally, from the other peoples of South America. Compared with the advanced civilization of to-day it may seem crude indeed, but if we take their products of handicraft separately into consideration, we shall find that they made most excellent thread and dyed it so honestly, that to-day, many a fabric a thousand or more years old has not lost its brilliancy of color. They were honest workmen as well as artists. It has often been asked would this culture in the interior of Peru have gone on developing, had not it been snuffed out by a really as savage but more powerful a people. It cannot be determined, but as civilization is merely evolution, there is no logical reason why the potter in Peru should not finally have vitrified and glazed his wares, and the metal workers have wrought even greater wonders with the product brought to them by miners who knew their work. Peruvian products in pre-Columbian time, never found a foreign market, but it is rash to say they never would have found it, had they not been molested and their career destroyed for all time by the infamous invader.

Whether in North, Central, or South America, there were centres where things higher than mere animal wants found chance to flourish and the upward growth toward rational rather than mere physical man took place, and all about these centres, roamed those out-lying people, who were not degenerates, but the as yet unadvanced descendants of that original people of the early stone age to whom it fell to populate these two continents. See also MOUND BUILDERS.

Bibliography.— The bibliography of American archæology is more extensive than comprehensive and much more theoretical than practical. The 'Smithsonian Contributions to Knowledge' (Washington, D. C., 1847–1900) contain many important monographs; also the 'Annual Reports' of the same institution. The volumes of the 'Antiquarian Society of Worcester,' Mass., of the now non-existent American Ethnological Society, also, are valuable; likewise the 'Annual Reports of the Regents of the State University,' Albany, N. Y. The Bureau of Ethnology, Washington, D. C., has issued an annual volume of inestimable value for many years; and the publications of the Peabody Museum of Archæology, Cambridge, Mass., and certain of the bulletins of the American Museum of Natural History, New York, are authoritative and necessary for a full understanding of the subject. The separate works that have been published are of less importance. Those prior to 1850 are purely of a speculative character. Of later date, the works of Brinton are of most importance; notably his 'American Race'; 'Essays of an Americanist'; and 'Notes on the Floridian Peninsula.' Of equal importance is Bancroft's 'Native Races of the Pacific Coast.' See also, Dellenbaugh, Moore, Jones, and Mercer, for résumé of subject covering North America, Florida, the Southern States, and valley of the Delaware River, in the order named.

Mexico.— Kingsborough 'Antiquities'; Mayer 'Mexico as It Was and Is'; Humboldt 'Vues des Cordillères'; and the publications of Zelia Nuttall in the series issued by Peabody Museum, Cambridge, Mass., notably 'The Fundamental Principles of the Old and New World Civilizations.' See also Stephens, 'Yucatan.'

Peru.—Transactions of the Ethnological Society of London; biennial reports of International Congress of Americanistes; von Tschudi 'Peru.'

Brazil.— Bates 'Naturalist on River Amazons' (1863); Agassiz 'Journey in Brazil' (1868); Kidder and Fletcher 'Brazil and Brazilians'; R. F. Burton 'Explorations in Highlands of Brazil (1869).

Patagonia.—Dobrizhoffer 'Abiponer' (1822); Muster's 'At Home With the Patagonians'; and for South America generally, transactions of learned societies in Europe,— German, French, and English.

CHARLES CONRAD ABBOTT, M.D.,
Archæologist.

Archæology, Christian. See CHRISTIAN ARCHÆOLOGY.

Archæopteryx, är'ke-ŏp'tĕ-rĭks, an extinct bird exhibiting many reptilian characters, especially in having jaws provided with teeth and a long tail of many vertebræ; and it constitutes a link between birds and reptiles. It lived during the Jurassic period, and is by far the most ancient bird known. Its distinctness from all other birds is expressed by placing it by itself in a separate sub-class, the Archæornithes birds are the rarest of fossils, and this one is known only from two skeletons and a single feather, all preserved in the lithographic limestone quarries of Solenhofen, Bavaria. The skeletons, one in the British, the other in the Berlin Museum, are wonderfully well preserved in the fine smooth-grained stone, and have the impressions of the feathers in their natural position. They show that the Archæopteryx had short wings with primary and secondary feathers arranged much as in modern birds; but the bones of the wing are not so specialized for their peculiar use as in modern birds; the metacarpal bones are separate, and the digits free and complete, each with a claw on its tip, while in modern birds the first and third digits are rudimentary and the metacarpals fused into a single bone. The long tail of 23 separate vertebræ has the feathers arranged in pairs springing from the sides of each vertebra except toward the tip; in modern birds the tail-feathers spring from a triangular bony plate at the end of the short

rudimentary tail. (See BIRDS.) The teeth are like those of many lizards, sharp, conical, each set in a separate socket, and there is no horny bill as in modern birds.

The extinct Dinosaurs are the reptiles which come nearest to Archæopteryx, and it is probable that they are descended from a common stock, the ancestors of the birds becoming arboreal and acquiring rudimentary wings to assist them in leaping from tree to tree. A somewhat analogous case is seen in the fold of skin and hair which the modern flying squirrels have developed for the same purpose; if further developed and specialized this would enable them to accomplish true flight. In Archæopteryx the wings are short and the attachments for the breast muscles (those chiefly used in flight) are small in comparison with those of modern birds, so that the creature must have had very limited powers in this direction.

Archangel, ärk-ān'jĕl, a seaport, capital of the Russian government of same name, on the right bank of the northern Dwina, about 20 miles above its mouth in the White Sea. The port is closed for six months by ice. Archangel, founded in 1584, was long the only port which Russia possessed. Pop. 21,930. The province contains 331,490 sq. miles; pop. 348,500.

Arch'angel, an angel of superior or of the highest rank. They are seven in number, of which Michael, Gabriel, and Raphael are mentioned in Scripture.

Archbald, Pa., borough in Lackawanna County, 10 miles northeast of Scranton, on the Delaware & Hudson and the New York, Ontario & Western Railroads. It was first settled by Welsh miners in 1831 and is to-day essentially a mining town. It has 5 churches, 6 schools, and several imposing public buildings. Two silk mills give employment to 350 persons. Over 3,500 men and boys are employed in coal mining. Population (1890) 4,032; (1900) 5,394.

Archbishop, ärch'bĭsh'ŭp, a chief bishop. The attentive reader of the Acts of the Apostles, noting that nearly the whole missionary energy of St. Paul was expended upon the cities and chief towns rather than on the villages and the country districts, will be prepared to learn that there were flourishing churches in the leading centres of population, while, as yet, nearly all other parts remained pagan. So strong, however, was the evangelistic spirit prevailing, that a number of younger and less powerful congregations were called into being. The pastors of these new churches being called bishops, that term no longer appeared a dignified enough appellation for the spiritual chief of the mother church, and, about A.D. 340, the Greek title of *archiepiscopos* was introduced

An archbishop is often called a metropolitan. He exercises a certain supervision over the bishops of his province, who are called his suffragans; convenes and presides over them in provincial councils, receives appeals against their decisions in matters of discipline, and, in the event of the death of one of them, provides for the administration of the dioceses. In the United States, the Roman Catholic Church is the only one which has dignitaries of this rank, and in 1900 the entire country comprised 14 archdioceses, Baltimore, as the first established see, having the dignity of primacy.

In England the early British churches were, in large measure, swept away by the Anglo-Saxon invaders, who were heathens, and the country consequently required to be reconverted. The great southern centre from which this was done was Canterbury, then the capital of Kent, where King Egbert gave Augustine, the chief missionary, a settlement. In the north, York, the chief town of Northumbria, where King Edwin built a shrine for Paulinus, became the great focus of operation for that part of England; hence the two archbishoprics now existing are those of Canterbury and of York. The prelate who occupies the former see is Primate of all England, while his brother of York is only Primate of England, the superiority of the see of Canterbury, long contested by that of York, having been formally settled in A.D. 1072. The former is the first in dignity after the princes of the blood; the latter is not second, but third, the Lord Chancellor taking precedence of him in official rank. In Ireland the same distinction holds for Armagh and Dublin. When the Catholic hierarchy was established in England in 1850 Westminster was constituted the metropolitan see.

Archdale, ärch-dāl, **John,** American colonial governor: b. Buckinghamshire, England, probably about 1635. Ferdinando Gorges, the last proprietor of Maine, married his sister Mary in 1660, and in 1664 sent him to Maine to set up Gorges' government afresh in opposition to Massachusetts, under whose protection the settlements there had placed themselves. (See GORGES.) They resisted Archdale so fiercely that the next year he sailed for home, entirely baffled. In May 1681 he acquired a dubious title to a share in the proprietorship of the Carolinas, and in 1682 the proprietors commissioned him to come over and receive their rents from "Albemarle" (North Carolina). He was there by 1683, with the intention of settling permanently (as his daughter did) — perhaps drawn by a liking for the Quakers in the colony, he having been converted by George Fox. A few years later, however, he returned to England, and was one of the chief managers of the proprietary affairs. In 1688 he appears on depositions in the Gorges matter, private claims being still unsettled; but there is no evidence that he visited Maine again. In 1694, the Carolina proprietors needing some manager on the spot he was induced to become governor of South and North Carolina by the title of "landgrave" and the attendant barony of 48,000 acres; but it was not till 17 Aug. 1695 that he assumed the government at Charleston, and he retained it but a year, then turning it over to a deputy and returning to England again. The complimentary address of the Assembly on his departure has been taken literally as a proof of influential and pregnant statesmanship; but in fact he dissolved his first Assembly in haste from a quarrel over abatement of quit-rents, compromised with the second, left the Huguenots unenfranchised and the unsatisfactory Indian trade as it was and made no strong impress. His spirit was good, however: he treated the Indians with humanity and modified some hard restrictions on them, drew up a militia act (into which the Assembly unanimously re-

fused to put a clause exempting the Quakers), and established a bureau of public charities.

He is also credited with having introduced rice culture into the Carolinas, through a bag of rice which a merchant vessel brought from Madagascar and he distributed among his friends.

In 1698, elected a member of Parliament, he refused to take the oath but only to affirm, and was not permitted to take his seat. In 1707 appeared 'A New Description of that Fertile and Pleasant Province of Carolina,' by him, a vindication of his administration, of little value except for some original documents.

Archdeacon, ärch'dē'kŭn, an ecclesiastical dignitary next in rank below a bishop, who has jurisdiction either over a part of or over the whole diocese. He is usually appointed by the bishop, under whom he performs various duties, and he holds a court which decides cases subject to an appeal to the bishop. The dignity is still maintained in the Anglican, but not in the Roman Catholic Church, the canons or rural deans exercising the same functions as archdeacons.

Archduke, ärch'dūk', a duke whose authority and power is superior to that of other dukes, a title in the present day assumed only by the princes of the imperial house of Austria. In France, in the reign of Dagobert, there was an Archduke of Austrasia; and at a later period, the provinces of Brabant and Lorraine were termed archduchies. The Dukes of Austria assumed the title of archduke in 1156; but the dignity was not confirmed till 1453.

Archegosaurus, är'ke-gō-sō'rŭs, a fossil saurian reptile, found in 1847, in large concretionary modules of clay-ironstone, from the coal field of Saarbrück. Four species have been described. Prof. Owen makes it a connecting link between the reptile and the fish, and on these grounds: it is related to the salamandroid-ganoid fishes by the conformity of pattern in the plates of the external cranial skeleton, and by the persistence of the chorda dorsalis, as in the sturgeon, while it is allied to the reptiles by the persistence of the chorda dorsalis, and the branchial arches, and by the absence of the occipital condyle or condyles, as in Lepidosiren, and by the presence of labyrinthic teeth, as in Labyrinthodon, which, however, also ally it to the ganoid Lepidosteus. See STEGOCELPHALIA.

Archelaus, är'ke-lā-ŭs, the name of several personages in ancient history, of whom we need mention only Archelaus the son of Herod the Great. This prince received from Augustus, with the title of Ethnarch, the sovereignty of Judea, Samaria, and Idumea. His reign is described as most tyrannical and bloody. The people at length accused him before Augustus, who, after hearing his defense, banished him in A.D. 10 to Vienne, in Gaul, where he died. To avoid the fury of Archelaus, Joseph and Mary, with the infant Jesus, retired to Nazareth.

Archenholz, är'ʜen-hōlts, **Johann Wilhelm von,** a German historian: b. 5 Sept. 1743; d. 28 Feb. 1812. He took part in the closing campaigns of the Seven Years' war and retired as captain, 1763; traveled extensively in Europe, lived in England the greater part of 1769–79, and settled in Hamburg in 1792. His book on 'England and Italy' (1785), extensively translated, obtained a phenomenal success. A sequel to it was 'Annals of British History' (1789–98, 20 vols.). His 'History of the Seven Years' War' (1789; augmented 1793, 13th ed. 1892) is still the most popular account of that war.

Arch'er, Belle, actress: b. Easton, Pa., 1860; d. 1890. Her maiden name was Arabella S. Mingle; married Herbert Archer, 1880, and was divorced from him, 1889. She made her début in Washington, D. C., with Wm. Florence in 'The Mighty Dollar,' and later played leading parts in 'Pinafore,' 'Hazel Kirke,' 'Lord Chumley' (1888), and Tennyson's 'Foresters.' For a time she was leading woman with Sol Smith Russell.

Arch'er, Branch T., Texan revolutionist: b. Virginia, 1790; d. Texas, 22 Sept. 1856. He studied medicine in Philadelphia, practised many years in Virginia, and was repeatedly a member of the legislature. In 1831 he removed to Texas, and was one of the leaders in preparing for the revolution determined upon far in advance of the actual crisis. On 3 Nov. 1835 he presided over the celebrated "consultation" of the American settlers concerning independence, and immediately after was one of three commissioners — the others being Stephen Austin and N. H. Wharton — to solicit aid from the United States. The next year he became speaker of the House in the first Texan Congress; and he was secretary of war for Texas 1839–42, when bodily infirmity compelled him to retire from public life.

Arch'er, Frederic, organist and musical director: b. Oxford, England, 1838; d. Pittsburg, Pa., 1901. Educated at Oxford, London, and Leipsic, and held important positions as organist in Oxford, London and Glasgow, 1852–79. Organist Plymouth Church, Brooklyn, N. Y., 1880–85; conductor Boston Oratorio Society, 1887; founded Pittsburg Symphony Orchestra, 1896; organist Church of the Ascension, Pittsburg, 1899–1901. He gave recitals and lectured on musical subjects throughout the United States and Canada. Founded and edited 'The Keynote' (1885).

Arch'er, John, physician: b. Harford County, Md., 6 June 1741; d. there, 1810. Graduated at Princeton, 1760, and in 1768 received from the Philadelphia Medical College the first medical diploma issued in America. He raised and commanded a military company during the Revolution, served several years in State Legislature, was a presidential elector in 1801, and member of Congress 1801–7. He made several discoveries in medicine which have been adopted by the profession.

Arch'er, Thomas, an English novelist and essayist. His works deal with the conditions of the working classes and with social evils. Among the best known are: 'A Fool's Paradise' (1870); 'Profitable Plants' (1874).

Arch'er, William, an English author and critic: b. Perth, Scotland, 23 Sept. 1856. Educated at Edinburgh University; became barrister, Middle Temple, 1883. Went to London 1878, became dramatic critic of the *Figaro,* 1879–81, and London *World* since 1884. In 1899 he visited the United States to study American theatres. He has edited and translat-

ed Ibsen's 'Prose Dramas' (5 vols.); and with his brother translated Ibsen's 'Peer Gynt.' He has written 'Life of Macready' (1890); 'English Dramatists of To-day' (1882); 'The Theatrical World' (5 vols. 1893–97); 'Study and Stage' (1899); 'America To-day' (1900); 'Poets of the Younger Generation' (1901); 'Masks or Faces: a Study in the Psychology of Acting.'

Arch'er-fish, a fish reputed to be able to shoot drops of water from its mouth at insects in the air above, thus bringing the insects down where they can be seized. The name is most frequently applied to a single species, *Toxotes jaculator*, a fish six or seven inches long, a native of Java and the neighboring islands, which represents an aberrant group of chætodonts, or coral fishes (q.v.). This, however, is an error of identification, the true fish with this habit being a related small coral fish (*Chelmon rostratus*) of India. This genus has its mouth extended into a tube-like snout, forming a sort of nozzle. When it perceives an insect perched on a plant over the water, it swims to within a distance of from four to six feet, and then with surprising dexterity will eject a single drop of water with so true an aim as to knock the insect into the water where it is instantly seized. Captives will do this in a tank or aquarium; whereas experiments show that the Toxotes never does such a thing for which its mouth is entirely unfitted.

Arch'ery. Ages after the bow and arrow had disappeared in general use from Europe and many other countries, it was the universal arm both for war and sport in the Americas, from Patagonia to the Arctic Circle, and its use lingered on the borders of advancing civilization till within the memory of thousands living. It may indeed be considered the most characteristic American weapon, yet the practice of archery as a recreation is limited. A few societies of Toxopholites exist and hold monthly meetings and annual contests. The principal clubs are in the neighborhood of Washington, D. C., and of Cincinnati.

A faithful band, too, of whom the late Maurice Thompson, the author of 'Alice of Old Vincennes,' was the exponent, have continued into this 20th century to take the bow and arrow into field and forest, and to live while in camp by the product of their skill in its use. Several charming pen pictures may be found in the pages of 'Scribner's,' 'Harper's,' 'Outing,' and the 'Badminton' magazines, relating their hunts after turkeys, herons, wild duck, wood-duck, and squirrels, and even fish, in Florida, Georgia, Illinois, Indiana, and other States. For practical purposes, however, the attention may be confined to archery as popularly understood: that is, shooting at the target as a recreation and to acquire skill. This form of its use continued long after gunpowder had become common: in fact the first book of instruction in archery, that of Roger Ascham, the teacher of Lady Jane Grey, and professor of Greek at Cambridge, 'Toxophilius, or the Schole of Shooting,' was published in 1571, when the bow had practically become obsolete as a weapon of offense. The bow used for recreation is the long-bow and not the arbalest or cross-bow which was used by William Tell. That style of the bow was never popular in England. As gunpowder came more and more into use in sports, the interest in the bow and arrow faded. About the year 1760 the possibilities of archery as a builder up of the body and the eye-sight were rediscovered, and from thenceforward it had a lusty growth and has always had a considerable following of devotees both in England and America. Bows are made either of one piece of wood, or two or more strips glued together, preferably of yew. A man's bow is about six feet in length, and a woman's some half a foot shorter. A man's bow requires a pull of from 40 to 50 pounds, a woman's about half that amount. The distance shot varies with the kind of contest: a Potomac round consists of 24 arrows at 80 yards, 24 at 70 and 24 at 60. A double Columbia round of 48 arrows at 50 yards, and 48 at 40. A double York round of 144 arrows at 100 yards, 96 at 80 and 48 at 60. A double National round of 96 arrows at 60 yards and 48 at 50, and a double American round of 60 arrows at 60 yards, 60 at 50 and 60 at 40. The arrow's shape and feathering is a matter of personal inclination. The targets are four feet in diameter, made of banded straw with a canvas front painted in five concentric rings, the centre gold, then red, blue, black and white; the value in counting shots being, respectively, 9, 7, 5, 3 and 1. There are in the National meet also competitions for longest flight and annual team competitions of 96 arrows at 60 yards for men and 96 arrows at 50 yards for women.

Arch'es Court, the chief and most ancient consistory court, belonging to the Archbishopric of Canterbury, for the debating of spiritual causes. It is named from the church in London, St. Mary le Bow, or Bow Church (so called from a fine arched crypt), where it was formerly held.

Arch'ibald, Sir Adams George, Canadian statesman: b. Truro, Nova Scotia, 18 May 1814; d. Halifax, 14 Dec. 1892. He was secretary of state for the Dominion of Canada, and lieutenant-governor of the Northwest Territories, and Manitoba, later; and later held the same office in Nova Scotia. He was knighted in 1885.

Archidamus, är'kĭ-dā'mŭs, the name of several kings of Sparta. I. The son of Anaxidamus, who lived during the Tegeatan war, which broke out soon after the termination of the second Messenian war, in the year 668 B.C. II. The son of Zeuxidamus, and succeeded to the throne in the year 469 B.C. In the fifth year of his reign there was an earthquake in Laconia which almost destroyed Sparta. In that trying period the foresight of Archidamus probably saved the surviving citizens from being massacred by the Helots. In the discussions at Sparta and Corinth, which preceded the rupture with Athens, he acted a prominent part, and always as the advocate of peace and moderation. He survived the outbreak of the Peloponnesian war about five years, during which time he had the conduct of three expeditions against Attica and one against Platæa. Archidamus died in the 42d year of his reign, 427 B.C. III. Son of Agesilaus II. While yet a boy he prevailed on his father to pardon Sphodrias, who had dared to make an irruption into Attica at a

time of profound peace. In 371 B.C. he was sent to the relief of his countrymen who had been vanquished at Leuctra. In 367 B.C. he defeated the Arcadians and Argives in what the Spartans termed the «scarless battle,» because they had won it without the loss of a single man. Archidamus III. appears to have been a warlike prince, but he was neither a great general nor a great statesman, and makes but a poor figure in either capacity after such kings as his father and grandfather. IV. Son of Eudamidas I. and grandson of Archidamus III., was king of Sparta in 296 B.C. V. Son of Eudamidas II. Archidamus V. was the last king of the Eurypontid race that reigned in Sparta. When he was killed the rights of his children were disregarded and his crown was given to a stranger.

Archil, är'kĭl, or **Orchil,** ôr'kĭl, a coloring matter obtained from various kinds of lichens, the most important of which are the *Roccella tinctoria* and the *R. fuciformis*. The *Lecanora tartarea*, or cudbear, is another of the same nature; orchella-weed and dyer's-moss are common names for them. The *R. tinctoria*, or archil plant proper, is abundant in the Canaries and Cape Verde Islands, and in the Levant; the *R. fuciformis* also grows chiefly in warm climates, as the coasts of Africa (Angola) and Madagascar. The lichens, which are chiefly collected from rocks near the sea, are cleaned and ground into a pulp with water, after which some ammoniacal liquor is added, when the coloring matter, red, violet, or purple, is evolved and falls to the bottom. The red coloring matter of *Lecanora tartarea* produces litmus when lime or an alkali is added. Archil has a beautiful violet color. It is used for improving the tints of other dyes, as from its want of permanence it cannot be used alone.

Archilochus, är-kĭl'ō-kŭs, a Greek poet, classed by Cicero with Homer and Sophocles: b. in the Island of Paros, flourished between 720 and 660 B.C. While a resident of Thasos, he incurred disgrace by throwing away his shield in a battle. He was the inventor of iambics. His terrible invective is said to have caused several suicides. A hymn to Hercules was the most esteemed of his poems, and used to be sung three times in honor of the victors at the games.

Archimandrite, är'kĭ-măn'drīt, in the Greek Church, an abbot or abbot-general, who has the superintendence of many abbots and convents.

Archimedes, är'kĭ-mē'dēz, one of the most celebrated among the ancient physicists and geometricians; b. at Syracuse, about 287 B.C. Though, according to some accounts, a relation and certainly a friend of King Hiero, he appears to have borne no public office, but to have devoted himself entirely to science. We cannot fully estimate his services to mathematics for want of an acquaintance with the previous state of science; still we know that he enriched it with discoveries of the highest importance, upon which the moderns have founded their admeasurements of curvilinear surfaces and solids. Euclid, in his Elements, considers only the relation of some of these magnitudes to each other, but does not compare them with surfaces and solids bounded by straight lines. Archimedes has developed the propositions necessary for effecting this comparison in his treatises on the sphere and cylinder, the spheroid and conoid, and in his work on the measure of the circle. He rose to still more abstruse considerations in his treatise on the spiral, which, however, even those acquainted with the subject can with difficulty comprehend. Archimedes is the only one among the ancients who has left us anything satisfactory on the theory of mechanics, and on hydrostatics. He first taught the principle "that a body immersed in a fluid loses as much in weight as the weight of an equal volume of the fluid, and determined, by means of it, that an artist had fraudulently added too much alloy to a crown which King Hiero had ordered to be made of pure gold. He discovered the solution of this problem while bathing; and it is said to have caused him so much joy, that he hastened home from the bath undressed, and crying out, Eureka! Eureka! "I have found it; I have found it!" Practical mechanics, also, received a great deal of attention from Archimedes. He is the inventor of the compound pulley, probably of the endless screw, etc. During the siege of Syracuse he devoted all his talents to the defense of his native country. Polybius, Livy, and Plutarch speak in detail with admiration, and probably with exaggeration, of the machines with which he repelled the attacks of the Romans. They make no mention of his having set on fire the enemy's fleet by burning-glasses,— a thing which is in itself very improbable, and related only in the later writings of Galen and Lucian. At the moment when the Romans, under Marcellus, gained possession of the city by assault, tradition relates that Archimedes was sitting in the market-place absorbed in thought, and contemplating some figures which he had drawn in the sand. To a Roman soldier who addressed him, he is related to have cried out, «Disturb not my circle!» but the rough warrior little heeded his request, and struck him down. The conquest of Syracuse is placed in the year 212 B.C. On his tombstone was placed a cylinder, with a sphere inscribed in it, thereby to immortalize his discovery of their mutual relation, on which he set particular value. Cicero, who was appointed quæstor over Sicily, found this monument in a thicket which concealed it. Of the works of Archimedes there are extant a treatise on ‹Equiponderants and Centres of Gravity,› in which the theory of the lever and other mechanical problems are treated; on the ‹Quadrature of the Parabola›; on the ‹Sphere and Cylinder›; on the ‹Dimensions of the Circle›; on ‹Spirals›; on ‹Conoids and Spheroids›; the ‹Arenarius,› a speculative treatise intended to refute the popular notion that the number of grains of sand on the seashore is infinite by showing that a definite number might be assigned to a quantity of grains sufficient to fill the sphere of the fixed stars, remarkable as containing an anticipation of the modern discovery of logarithms; on ‹Floating Bodies›; a treatise called ‹Lemmata,› of doubtful authenticity, on plane geometry. A very complete and splendid edition of the works of Archimedes issued from the ‹Clarendon Press,› at Oxford, in 1792. Other editions appeared in 1881, and 1897.

Archimedes, Principle of. See ARCHIMEDES.

Ar'chime'des' Screw, a machine invented by Archimedes while studying in Egypt. Observing the difficulty of raising water from the Nile he is said to have designed this screw as a means of overcoming the obstacle. It consists of a pipe twisted in a spiral form around a cylinder, which, when at work, is supported in an inclined position. The lower end of the pipe is immersed in water, and when the cylinder is made to revolve on its own axis, the water is raised from bend to bend in the spiral pipe until it flows out at the top. The Achimedian screw is still used in Holland for raising water, and draining low grounds. The Dutch water-screws are mostly of large size, and are moved by the wind, one windmill furnishing sufficient motive power to keep several screws going at once.

Archipelago, är'kĭ-pĕl'a-gō, a term originally applied to the Ægæan, the sea lying between Greece and Asia Minor, then to the numerous islands situated therein, and latterly to any cluster of islands. In the Grecian Archipelago the islands nearest the European coast lie together almost in a circle, and for this reason are called the Cyclades (Gr. *kyklos,* a circle); those nearest the Asiatic, being farther from one another, the Sporades ("scattered"). (See these articles, and Cyprus; Negropont; Rhodes; Samos; Scio, etc.) The Malay, Indian, or Eastern Archipelago, on the east of Asia, includes Borneo, Sumatra, and other large islands. See Malay Archipelago.

Architecture, skilful, or at least careful, building; and it is in this sense that we speak of military architecture, naval architecture (qq.v.), and the like. In a general sense, building which has been made interesting by artistic consideration, the proportions of the structure having been considered, its details treated in a deliberate way, ornamentation applied whenever practicable, and the whole structure imbued with the artistical spirit. Of course architecture in this sense cannot exist without civilization, and the beginnings of civilization are commonly marked by an artistic treatment of buildings, such as huts for residence and larger cabins for the meeting of a tribe or its chief men. Buildings dedicated to religious purposes always appear early in the advance toward higher civilization: and it is mainly in temples and churches that architectural development appears, in any age. In this article it is intended to describe and analyze the architecture which has given rise to European styles, and those European styles themselves, from the commencement of history until the close of the 19th century. For the architecture of the Far East such as India, Farther India, China, and Japan, and for the primitive architecture of America, see separate headings.

The most primitive races using architecture of which we have any knowledge, are those of the Pacific islands in our own time. In New Zealand especially the large huts have much decorative woodwork combined in an intelligent way to produce a general effect. Again in the islands of Micronesia the larger residences and the buildings of the community are designed according to a very strict and semi-religious tradition.

Now this same kind of tradition, more or less closely united with the pious beliefs of the people and with the teachings of their priesthood, is found to have existed in Egypt at a time not exactly prehistoric, because we are gradually approaching to an accurate knowledge of the dates, but of an epoch not as yet exactly fixed — an epoch at least 5,000 years B.C. From that time on for many centuries the plan of a palace, or of a temple, or of one of those great buildings in which palace and temple seem to have been united, was a thing almost absolutely fixed in advance; and moreover the external ordonnance, the succession of pylons, the colonnaded porches, would be unchanged except as to minor considerations. One temple would have colossal statues backed up by the piers of the façade; another would have a row of columns with enriched capitals and sculptured drums; all these changes would find their explanation in the changing fashion of the time; but the general disposition of the covered buildings alternating with open courts and culminating in a shrine accessible only to the few, would be unchanged. The origin of the forms of Egyptian architecture is undoubtedly to be found in the building with a light skeleton of reeds daubed with mud, but this structure left only its superficial appearance to the stone temples which were to succeed it. In actual building no race was ever more thoroughly skilled in quarrying, cutting, transporting, and combining blocks of limestone, and more rarely of harder rocks. These materials they used chiefly to provide themselves with broad surfaces — sometimes flat, as of a sloping wall, sometimes rounded, in an approximately cylindrical way, as in a huge column; and these surfaces they enriched by sculpture in low relief and especially in that coelanaglyphic relief in which the background is not cleared away; and these reliefs they painted richly in brilliant colors. At a later time and especially for interiors the painting was done upon smooth walls and ceilings, and a whole school of flat pattern designing was developed, equal in effectiveness to any decorative painting of more recent times.

The culmination of Egyptian architectural art is to be found at a very early date. Many persons will think that it never again attained the dignified splendor of that which dates from the 25th century B.C. One thing at least, is certain — technical perfection has never, in any land, surpassed that with which huge blocks of granite, squared and polished and inscribed with complicated patterns, were used in buildings of that time. Still the 17th and 18th dynasties, which are now dated 1610 to 1320 B.C. (Flinders Petrie), will seem to most students the time of the greatest Egyptian architecture, for it was then that the great buildings at ancient Thebes were built, including temples and palaces, where now stand the modern villages of Karnak and Luxor, on the right bank, and, on the left bank, Dahr-el-Medinah and Medinet-Habu, with all the remains of the great necropolis. All of the buildings here named or included by implication were really for residence or ceremonial, excepting the tombs, the interiors of which are of surprising beauty of decoration. The famous Pyramids, whether the great ones of Gizeh, which are the oldest, or the much smaller ones of later times, are not architecture in the æsthetic sense except as they are carefully wrought, the slopes of their sides accurately de-

HATHORIC COLUMN, TEMPLE OF DINDERA

(Restored)

termined, their placing by the points of the compass very precise, and the whole structure invested with a quasi-religious character. Artistic design is hardly to be assigned to them; indeed the great pyramids are nothing but cairns, that is to say, heaps of stone within which a couple of chambers have been carefully laid out; technical excellence is never at fault, and some astronomical knowledge is evident in the placing and shaping of the structure, but this does not constitute artistical building.

The architecture which was contemporary with this in Syria and Mesopotamia is hardly known to us as yet; the results of it are traceable in the buildings of Nineveh, dated the 8th and 7th centuries B.C., but even this has perished so generally that there has been much dispute as to the manner of roofing the palace halls. The decision of recent archæologists is that these halls, long and narrow, and enclosed by walls of unburned bricks but of enormous thickness, were roofed with wagon vaults, also of unburned brick, curious devices being employed to let in the breeze sweeping over the low, flat land bordering the Tigris, while excluding the burning sun. The decoration of these buildings must have been largely by means of sculpture, flat slabs of alabaster which lined the walls being exquisitely carved in low relief with subjects of war and hunting, or of the king doing worship to his gods. Much more massive sculptures were carved in great blocks of limestone for the gate-posts, such as the huge winged lions and winged human-headed bulls of which specimens have been brought to the Louvre and to the British Museum. The characteristic of these palaces was their position upon the flat tops of the somewhat broad artificial terraces paved at a height of 25 or 30 feet above the country around, from which pavement arose the principal rooms of the residential buildings and the more tapering mass of the great temple. These temples were apt to be built with steps, but were otherwise pyramidal in form. They never reached a height approaching that of the Pyramids of Egypt, nor were they of anything like the same solidity of structure, being generally built of unbaked clay in cast blocks, such as we call crude bricks, and faced with burned bricks. Such a structure crumbles into mud or dust when neglected, and the huge mounds along the Euphrates and the Tigris which have been opened and within which the treasures of Babylon and Nineveh have been found, are made up of this debris.

The architecture of ancient Persia dates from about 500 B.C., as far as our knowledge goes. From this time on until the conquest by Alexander, 334 B.C., that ancient Persian art which we call Persepolitan from the famous ruins at the site of ancient Persepolis controlled all that inland country of Asia which lies immediately east and north of Mesopotamia. It was an architecture of terraced palaces and halls of many columns, but the terraces and platforms not being needed in a hilly country, were much lower, evidently serving merely for splendor, as the European palace is often raised upon an architectural basement. The chief value of this art to European students is in the beginning of that wonderful system of decoration by means of colored patterns, both flat and in slight relief, in which for two thousand years the Persians were the masters of the world, teaching the races of Asia as well as of Europe what pattern-making and the application of brilliant colors to a flat surface might produce.

Contemporary with the latest Assyrian work were the beginnings of Grecian architecture, and contemporary with Persian work as above alluded to, came the culminating period of Greece. There had been at a previous time the strange Mykenæan art which cannot be dated with any accuracy, and which is far more Asiatic than Greek, and which as we now know, was more fully developed in Crete and perhaps in Cyprus than in the mainland of Greece. Of this art we have little in the way of permanent buildings. But with the year 600 B.C. the beginnings of the Doric style appear, the quarries of marble and of softer stone are worked in an intelligent way and the round column with the square abacus is used to form colonnades. The temple of those early days was that which it continued to be till the fall of all Grecian civilization came at the close of the classical epoch. It was a shut-up room without windows, divided, when very large, with columns in two rows, and perhaps lighted from above either by sky-lights or by some system resembling that of the mediæval clearstory, but of this we have no knowledge. The great eastern and western doorways were the only means of admitting daylight to which we can certainly point. Only a few temples had a colonnade on every side as had the Parthenon, the so-called Temple of Theseus at Athens and other buildings in Greece and in the colonies. By far the greater number had a portico at one end, the east, or one at each end; the wall of the enclosed chamber or naos (called cella by the Romans) showing at the northern and southern sides between the porticoes at the ends. Of other buildings than temples we know only porticoes, roofed, but open on at least one side. Otherwise we have no knowledge of Grecian buildings. Gate-way buildings (propylaia) were roofed in part but served merely as passageways: when enclosed rooms were attached to them, these are ruined, and we know nothing of their ordonnance. There was also the meeting hall at Eleusis with many columns supporting the roof, but what its interior disposition was we do not know at all. So with dwellings, some little is known of the plan of a Grecian house, but no one has ever a reasonable theory as to its architectural treatment.

The reason why Grecian architecture has obtained such a prodigious hold upon the imagination of Europe is the control which its beauty and refinement, when in their full glory, exercised over the intelligence of the great Roman Empire. From 200 B.C. at least until 350 A.D., all the world which was destined to become European in feeling and much that has not retained that European character, was largely controlled by the great influence spreading from the city on the Tiber; and this influence, so far as it was artistical, was derived in its turn from the cities of Greece. It was the mission of the Roman Empire to spread and perpetuate Hellenism, and it is to that combination of influences that the tradition and the learning of Europe are what they are in contradistinction to that of India, China, and the other ancient lands of Asia. The peculiar charm of Greek art was in its extreme subtlety of proportion, and in the

grace and refinement of its details; but in gaining these advantages it lost variety, movement and life, and deliberately shut itself off from much that is absolutely essential to the modern world. Thus no man can build a house now in the Greek style, because he is absolutely ignorant of what a Greek would have done with a large hall, or with a group of five or a dozen small rooms and passages. He does not know how a Greek would have made a window; he has no knowledge at all of how a Greek would have put one story upon another; in other words, Grecian architecture remains for us as an astonishing piece of perfection of limited range and small adaptability.

The artists and the engineers of the great Roman Empire inherited the Etruscan notion of building with the round arch built of voussoirs or wedge-shaped slabs — a thing never used by the Greeks in architecture. The Roman commonwealth at its commencement was as much Etruscan as Latin, and this use of the vault, together with the free employment of glazed and painted earthenware for the interiors of buildings was perhaps common to both races, but was certainly familiar to the people of Etruria. Helbig points out that the boast of Augustus of "having found Rome a city of brick and leaving it marble" had a more exact significance than appears on the surface, for the Rome of the days of Julius, the Rome which Octavianus must have seen as a child, was really a city of brick houses with terra cotta ornaments. But the Greek invasion had begun earlier than the days of Julius, and he himself was destined to be the great introducer of the refined columnar architecture of Greece into his native city. Augustus and the following emperors and their admirers and followers within and without the Imperial City took up this mode of building with the long rows of marble columns, and from London and the Strait of Gibraltar eastward to the sands of the Arabian Desert, the common style of beautifully ordered pillars carrying roofs light in proportion to the substructure made the cities splendid. The cities of the East were particularly famous for their colonnaded streets, and those of Palmyra, Gerasa and Antioch were unsurpassed except in the Imperial City itself.

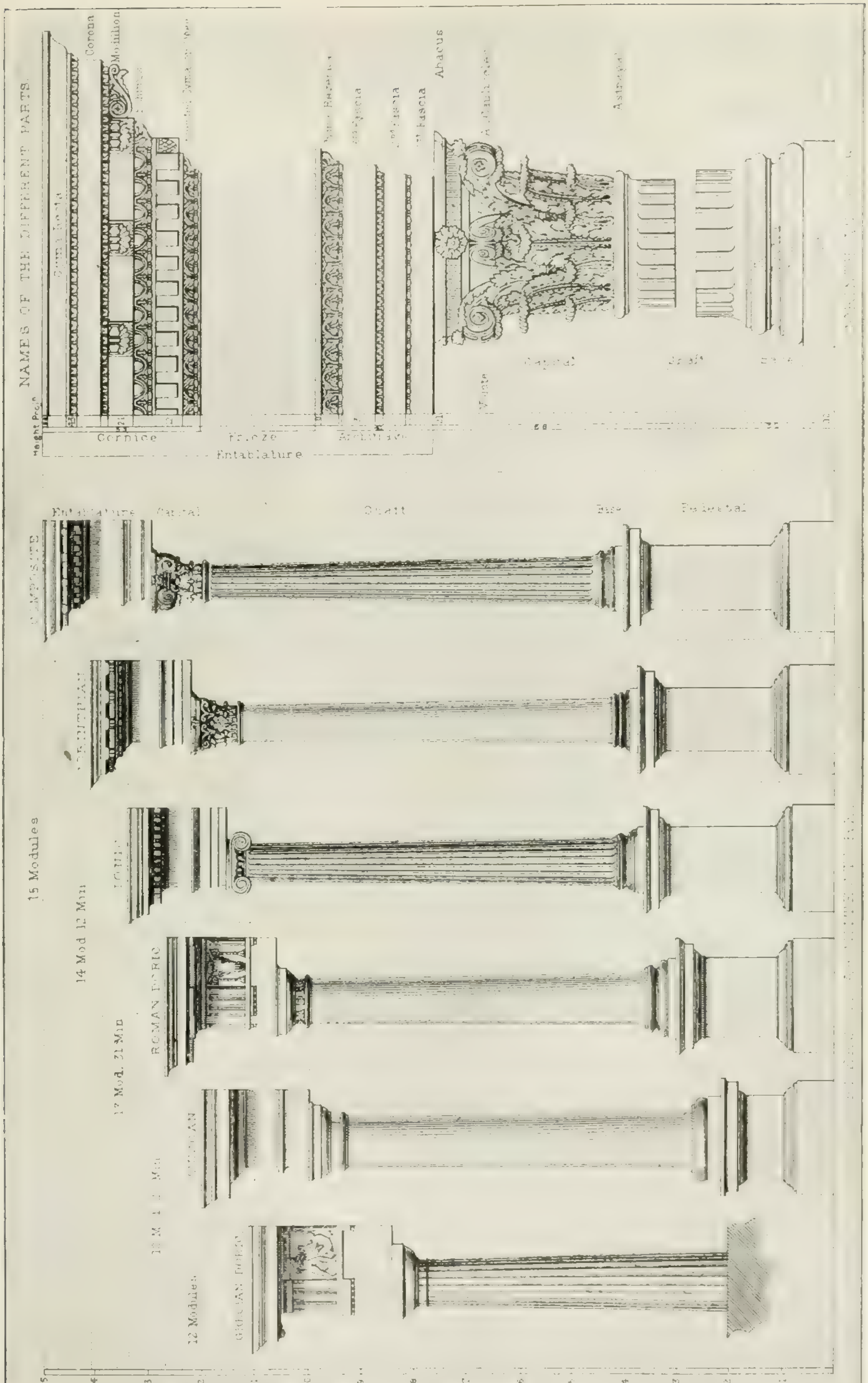
The Romans developed also a totally non-Greek system of building with small stones laid in quantities of rather liquid mortar, making of this masonry very heavy walls, which were faced and rendered smooth by brickwork of thin, hard-baked tiles, laid also in mortar. These halls and passages they vaulted in the same materials, and made them solid and immovable. They desired, of course, to combine their great porticoes with their vaulted interiors, and great ingenuity is shown in reaching an approximate success in this matter. See Roman Imperial Architecture.

These two traditions struggled together in the work of small communities, the impoverished states which grew up over the ruins of the Empire. Christian churches had to be built in the East as in the West. It is curious to note that the West took up the colonnaded style and built what we call basilica churches, that is, buildings whose plan is a long parallelogram divided by rows of columns lengthwise through it; while in the East the vault generally prevailed, and gave birth to what we call Byzantine architecture. The fact of this Eastern preference for the vaulted system points to what has been thought the probable origin of the Roman vaulting, namely, in Alexandria and other cities of the Macedonian Empire, as divided into the kingdoms of the Diadochi, the successors of Alexander the Great. No traces of it have, however, been identified. Round and polygonal churches were not unknown in the West. Basilica churches also existed in the East, but very few, and of very early times, the 5th and 6th centuries; but the Byzantine style, based entirely upon vaulting of great boldness, but lighter and far less enduring in appearance than the Roman work, was destined to be, from that time on, the characteristic of Christian architecture of the Levant and also to be the inspiring thought at the bottom of the architecture of the Mohammedan conquerors. The first perfectly realized Byzantine building is also the greatest — the Church of Saint Sofia in Constantinople was finished between 532 and 537 A.D., but partly rebuilt in 563. It may well be thought the most beautiful of churches, but in saying this one has in mind the interior only. All church building, even the latest and richest Gothic, has the exterior for its chief splendor. It is only true that the exterior is more entirely disregarded by the Byzantines and apparently no thought whatever given to the effect of the external shell. The style invented in this way at a single effort (a result not known to have been achieved anywhere else in the history of art) has prevailed ever since over all the lands from the Red Sea northward and even over all the plains of Russia, if we are considering church architecture alone. The more recent buildings of Asia Minor, Armenia, The Caucasus, Moldavia, Greece and Russia to the Baltic, may be without direct reference to Byzantine systems of design so long as they are merely low walled residences, or if larger and built of timber; but the church is everywhere Byzantine. The boundary between this and the Romanesque art of western Europe runs along the eastern frontier of Dalmatia and then eastward somewhere near the Danube; for Hungary is generally western in its church architecture, while the Balkan Peninsula is Byzantine.

The Romanesque of western Europe is a style almost wholly based upon church building and characterized by an effort to be as Roman as possible under changing conditions. From the first the struggle to vault every nave and aisle and sanctuary in the classical Roman way is obvious, but also it is obvious that the small means and the poor skill of the people held them back all the time. Under these conditions there grew up in Italy a Latin style, partly the result of copying classical basilicas and partly of copying the interiors of great Roman houses which had often been the refuge of a poor and timid congregation of Christians. This style is best known also from the churches of Ravenna and the oldest churches of Rome. There was also a Lombard style in the north of Italy, partly the result of the invasion of barbarians, partly of Byzantine invasions coming from the East. Again there grew up slowly the beautiful Pisan style of central Italy: and all these styles may be included in the general term Romanesque.

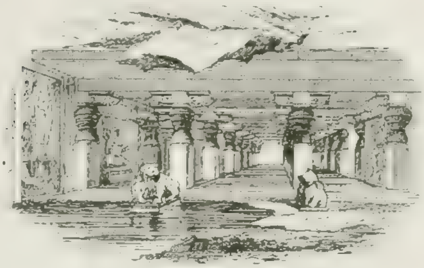
In the north of Europe nothing earlier than the 9th century is accurately known to us, and even of that epoch the buildings which we know

ARCHITECTURE.—I.

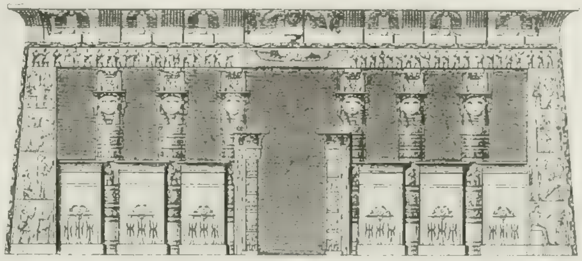


ARCHITECTURE.—II.

OBELISKS, LUXOR, EGYPT



ROCK TEMPLE OF ELEPHANTA, INDIA



TEMPLE OF TENTYRA, EGYPT

[illegible]

[illegible]

THE PARTHENON, ACROPOLIS, ATHENS

are few in number and often greatly rebuilt. Such a building is the church at Aix-la-Chapelle in Rhenish Prussia, the cathedral built by Charlemagne himself, but it has been altered out of recognition. There is a conventual church at Hechingen, near Stuttgart, and at Quedlinburg in Prussian Saxony, and these churches are marked by a beautiful system of quasi-classical sculpture with scroll-work and elaborate moldings, and by a system of vaulting with groined vaults very effective but not allowing of very great variety of structure. The vaults are low and narrow, and even under these conditions the history of every great church is a record of constant accidents befalling the vault. The noble cathedral of Speyer, the capital of Rhenish Bavaria, and the church at Gernrode belong to a later period, namely, the 12th century, and of the same time or a very little later are the church of St. Godehard and the church of St. Michael at Hildesheim, the Cathedral of Mainz (Mayence), of Braunschweig (Brunswick), and the Cathedral at Worms. These great churches have held their own, unchanged in important details, since the time of their first building, and but for these and a few more we should not know how interesting and on the whole efficient a style the northern Romanesque could be. On the other hand the churches of middle France are more rich in sculpture. Nothing can exceed the splendor and, in a limited sense, the beauty of such fronts as the Cathedral at Angoulême, and Notre Dame la Grande at Poitiers. The Cathedral at Le Puy has also much beautiful sculpture, but is especially famous for its surprisingly picturesque situation and design, and its very beautiful polychromatic exterior. The Church of La Madeleine at Vézelay, and that of Notre Dame du Port at Clermont, are great steps in the development of the Romanesque churches leading to the Gothic style: and in the far south the churches at Arles, Saint Gilles, and Saint Saturnin at Toulouse, are examples of a rich and brilliant Romanesque quite different in character from anything in the north of France, or in Germany. France has also a great number of domed churches partaking strongly of the Byzantine character.

There is beautiful Romanesque also in England, where the nave of Peterboro and that of Winchester are splendid examples; and in Spain some of the richest churches in Europe are of this style.

The far North — Denmark and the Scandinavian Peninsula — have also beautiful Romanesque, as in the Cathedral of Lund in Sweden; but the characteristic architecture of Norway is a style depending upon wood for its structure and upon elaborate carving for its decoration.

The above considerations bring us to the middle of the 12th century and at this point it becomes necessary to consider the works of the Mohammedan nations, who were following in the main the Byzantine style. Some of the earliest of these Mohammedan churches have a disputed date; thus the famous Mosque of Omar in Jerusalem has always been a point of dispute, some historians putting its structure as early as the beginning of the 8th century. It is known that the early mosques at Cairo, such as that of Ibn Tulun were built in the 9th century. The architecture of a later time is more splendid if less massive and constructional. The Moslem architecture spread east and west in the trail of the conquering armies, and there is a Mohammedan style in India of extraordinary splendor, its chief epoch being between 1180 and 1600 A.D. (See INDIA, ARCHITECTURE OF.) The conquest of northern Africa and of nearly all the Spanish Peninsula gave rise to what we call the Moorish style, never equal in dignity or beauty to the architecture of Cairo and Damascus, but enriched with elaborate but fantastic carving, and also plaster work modeled and stamped, and all richly painted. The most celebrated buildings of this style are the Mosque of Cordova and the Palace of the Alhambra on the hill near Grenada. The tendency of the Eastern mind is seen in rich chromatic decorations, not only in paintings but also in rich enameled tiles with which large surfaces of wall are adorned, and also at least in the wealthier cities, with exquisite inlays of colored marble.

In the middle of the 12th century, the peoples of what we now call France, western Germany, England, and Belgium were building skilfully and intelligently in their Romanesque style, but were still much harassed by the difficulty of the round arched vault. This difficulty was peculiarly great when it became necessary to carry a deambulatory like an aisle around a semicircular apse. All the ingenuity of the builders was put into this, and without perfect satisfaction to them. There was then taken up a device which seems simple and rather obvious, the device of springing a narrow arch of very solid material from one pier or column or corbel to another, and building as many such arches as the space to be filled made necessary — then filling up the resulting spaces with light vaulting which rested upon these cut-stone arches. To take the simplest case, if a parallelogram of 900 square feet were to be filled, it would take a fairly good builder to make a groined vault stand; but any beginner could build four narrow arches on the four outlines of the square and two other arches diagonally dividing it into four panels, each of about 200 square feet. Anybody could fill one of these with a thin shell of vaulting: and it is out of this simple device that there grew the great Gothic architecture. The diagonal arches met in the middle at a kind of boss. We may then consider those diagonals as consisting of four half arches meeting in the middle. Looked at in that way, irregular spaces could be vaulted without trouble and the plan of the church might be as elaborate and complicated as bishop or master builder might desire.

Constructional Gothic architecture is merely Romanesque with this rib-vaulting and the resulting lightness and freedom added; but decoratively there came into it a great enlargement and enrichment of the Romanesque sculpture. The carvers grew wonderfully more learned in their knowledge of anatomy, and of the human figure in movement and in repose, and they learned to cast drapery in the most effective way, so that the culminating sculpture of the 13th century may rank with the architectural sculpture of Greece in beauty. Representing this perfection of the style we have the Cathedrals of Reims, Bourges, Amiens, the north and south flank of Chartres (for the west end is partly of earlier, partly of later epochs) and a vast number of smaller churches and fragments of churches; thus one of the finest apses in the world is that of Le Mans. The Gothic style is

French in its origin and development, but the English took it over at a very early date and built the lovely cathedrals of Salisbury and Lincoln and the still earlier east end of Canterbury. In fact, English Gothic is of the most fascinating character, though without the vastness and dignity of the French and without its logical perfection. There is splendid Gothic architecture in Spain very closely copied from the French, and in Germany the succeeding French styles are continually reproduced with modifications — the Germans very properly clinging to their noble Romanesque and only in part accepting Gothic achievement.

The early development of Gothic architecture was checked by the civil wars in what is now France — the quarrels between great nobles and the invasion of the English kings, Edward III. and Henry IV. claiming the crown of France. In this way the century from 1345 to 1453 was a time of almost continual disorder, and but little architectural change took place during that time. What little was built in the 14th century is of extreme interest, such as the Church of Saint Ouen at Rouen in Normandy, marking the very culmination of formal and regulated Gothic. In England, too, the Gothic style worked out its own evolution with singular results. The remarkable nave of Lincoln Cathedral and that of Litchfield were built with vaulting a little artificial in that many more ribs were put in than were needed, and this led immediately to what we know as fan tracery, which marks the close of the 14th and the first half of the 15th century. The most splendid specimens of this are of the 15th century, but its earlier examples, such as the cloisters of Gloucester Cathedral, are contemporary with the English perpendicular Gothic and belong to the last few years of the 14th century. Gothic art was also introduced into Italy; but it had no complete mastery there. Its nature was hardly understood by the Italians, but beautiful and highly decorative churches and city houses resulted from their work with it.

With the close of the Hundred Years' War there appeared all over northern Europe the style which we call Florid or Flamboyant architecture, but it is to be noted that the glory of this style is almost exactly contemporary with the rise of the classical Renaissance in Italy. From 1453 till 1525 the Florid Gothic was in the main undisturbed in France, and a similar style prevailed almost undisturbed in Germany, Flanders, the Low Countries and England; but all this time the buildings of Italy were without exception built in what was intended to be the classical Roman style of architecture. This period, which should be called by the Italian name, the Risorgimento, is therefore to be studied by itself in Italy, and the style of the Risorgimento, beautiful in itself and full of interest, has this further hold on our notice that it was destined to prevail over all local styles and to turn the people of Europe toward the imitation of Greco-Roman art. The classical style of Italy has, of course, the fault of being a deliberate re-study of a style long before forgotten and abandoned — that is to say, it did not grow naturally from the study by each master builder of the buildings of his predecessors and contemporaries — it was studied deliberately because it was felt that the remains of the great civilized empire of Rome must be better than the work of the comparatively disorganized and scattered peoples of mediæval Europe. This fault disappeared, however, after the first few years of hard and persistent work, by so many artists all working together; and yet it is certain that in architecture there was less of a success achieved than in other forms of decoration, and in painting and sculpture conducted with the purpose of recording expression. What we call the Renaissance architecture of Europe was not destined to develop any new system of building nor any system of sculptured or painted decoration except as it offered room for beautiful separate works of art to be put into place on its walls and in its niches. The Italian influence reached the North early in the 16th century and by 1525 it was established in France.

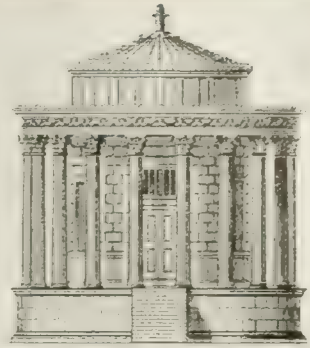
The important buildings of this neo-classic style were in Italy very largely ecclesiastical. There had not been during the 13th century such a wonderful building of churches in Italy as in the North, and so when the new style came in there was room for more. Of the early date are such churches as Saint Zaccaria and Saint Fantino in Venice, the church at Montepulciano and the similar one at Cortona on the hillside, and the church of Saint Andrea at Mantua. There were also a number of city residences of the nobles, buildings which we call palazzi, and some of these, such as the Palazzo Rucellai, the Palazzo Riccardi, the Palazzo Strozzi, and the Palazzo Pitti in Florence, with some of the most exquisite private houses in the world on the canals of Venice vie with the most important churches of the period. Again in the 16th century the architecture, though less varied and natural, seeming also comparatively cold and hard, as if the delight in it had gone out of its creators, is full of excellent examples for all students. In the North great country mansions were the first to receive and show the Italian influence, and very splendid buildings of this sort were built in France during the reign of Francis I. and Henry II.; while in England during the contemporaneous reigns, the curious Tudor and the still more interesting Elizabethan style were not showing marked Italian influence and yet were evidently not simply the development from the latest English Gothic. It is curious, however, that the use of Gothic details and even of Gothic building lasted in England far into the 17th century, though it was then not very general.

By 1650 all marked separation of style between the countries of western Europe had disappeared. All the peoples were building alike in the modified Roman style, with classical columns or studies made from them, and with complete abandonment of all mediæval forms. The great influence over taste of the brilliant court of Louis XIV., the building of Marly and Versailles, had a still greater influence over the capital cities and royal palaces of Europe, for every sovereign prince (and there were hundreds of them at this period) felt himself obliged to try to build a little Versailles for himself. In this way the universality of the later neo-classic was established; and this prevailed continuously down to the outbreak of the French Revolution. It is not meant that there were no changes nor that there was a lack of intelligence and thought, for there were architects of real merit and there

ARCHITECTURE.—III.

ARCH OF TITUS, ROME.

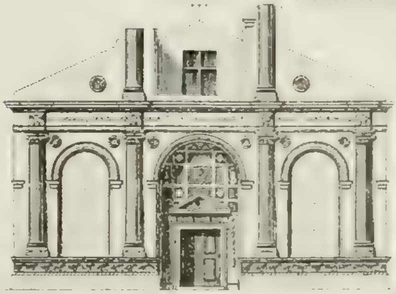
MONUMENT OF LYSICRATES



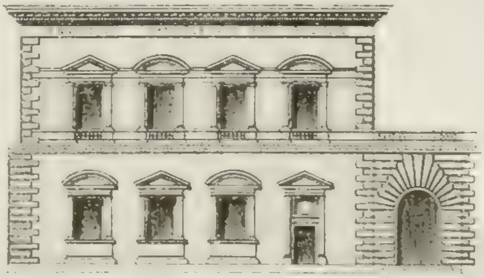
TEMPLE OF VESTA, [illegible]

RESTORATION OF THE FORUM, ROME

[illegible]



CHURCH AT RIMINI



PALAZZO [illegible]

were modifications of style so decided that there is no difficulty in dating a good piece of architecture; but the curious fact that this universally prevalent architecture observed two rules and not one, gave it in all its forms a marked characteristic. In every other strong and prevailing style that the world has known, tradition and the handing on of rules from master to pupil was the one cause of uniformity and the one route of change; but now for the first time there was a body of ancient learning and often of misinformation about the Greco-Roman past to which every one referred as to an authority greater than that even of his master and of his contemporaries.

Since the close of the Napoleonic wars in 1815 there has been throughout Europe and in the lands settled by Europeans an architectural situation altogether unique in history. There has been no universal and no generally prevalent style except that the later neo-classic in one form or another has been continually in use. Every other imaginable attempt has been made; and there have been earnest and resolute studies in Romanesque, Gothic, Mohammedan and even Byzantine art, and experiments have been made in Egyptian, Persian and other far removed styles. The early Renaissance, too, both that of Italy which we called above that of the Risorgimento, and the Renaissance proper of France; and the English Elizabethan and Jacobean, and the spirited and picturesque German Renaissance of the 16th century, all have been tried. Modern architects have not merely sought inspiration in the buildings and in drawings and photographs of the buildings, but they have tried to copy them either complete or in great part, large details and small, and it is largely true that the 19th century was so poor a time for decoration because all the designers had their portfolios full of examples of old work finer than anything they could produce. They were trained to copy and adapt, and in this way prevented from trying to design in a natural way. In Bavaria the traveled and studious prince who was afterward King Ludwig I. (dethroned 1848) built a whole series of palaces and official buildings in the capital city, Munich, and in its neighborhood, trying in turn to reproduce Byzantine, German Gothic, Florentine Renaissance, Greco-Roman and Greek as nearly as he dared. These buildings are permanent and solid structures, and a serious attempt was made to build up in this way a museum of architectural art, a thing absolutely inconceivable to a sovereign in the days of living architecture. There has been a German classical school, of which the chief centre was Berlin, and there have been several picturesque or semi-Gothic schools, but none of them permanently successful. During the last 20 years of the 19th century two influences were seen side by side, the one a determined effort to revive the latest neo-classic — the *Barock* of the German 18th century; and the other a very realistic study of the requirements of the building and of natural form for its ornamentation. In this last mentioned style very beautiful effects have been produced by means of stucco relief combined with the stuccoed brick front of the large city houses and public buildings, and also great boldness in the way of wrought-iron work used as an important part of the façade. In Belgium, especially in Antwerp, this use of wrought iron is very noticeable and effective. In England the Gothic revival which began as early as 1845 had largely a religious foundation, and in part a mistaken national feeling behind it; but in the main it was a protest against what was thought the artificial style derived from the teachings of Palladio and his latest imitator, Sir William Chambers, and a desire to return to a constructional art. It failed of success because at no time did it command the adhesion of more than a certain large fraction of the whole number of architects, and also because its advocates themselves did not agree as to the style which they were to develop. Great freedom was shown in adapting motives from different countries and different epochs. Thus the Italian Gothic, with a free use of color in external and internal design, was followed with great energy, sometimes in the way of close copying, sometimes in the way of bold adaptation. This resulted in admirable single buildings, but it added to the confusion of aim and purpose and prevented the building up of a consistent school of design.

This curious architecture, with pointed arches, colored material used in stripes and patterns, shafts of polished marble or granite, and architectural sculpture of very naturalistic quality, has been called the Victorian style, or Victorian Gothic. One of its earliest examples was the London church in Margaret Street, Cavendish Square. But the masterpieces of the Gothic revival are such buildings as the Cathedral of Truro in Wales, and that of Adelaide in South Australia, which are really Gothic buildings though built in a modern way to meet modern requirements. In France the tradition of the reigns before the revolution and of the brief empire of Napoleon were so strong and were represented by so many highly trained architects, sculptors, decorative painters, wood-carvers, and stone-cutters that no serious attempt was ever made to change the style of the whole country. Individual architects and archæologists preached the glory of the French mediæval tradition and occasionally a great convent would build its church in a really vigorous and well-understood Gothic manner, but in general the style of the epoch was developed according to the teachings of the central school in Paris, so that while the long rows of handsome dwelling houses and the stately Préfectures and Mairies of France were built in what might be called an orthodox French neo-classic style, the exceptional buildings are, in a curious way, harmonious with the general result. Thus the famous building on the Trocadéro Hill has largely a Byzantine character, and yet does not strike one as wholly out of keeping with the neo-classic house-fronts near. The great Hôtel de Ville of Paris, built after the destruction of the former one in 1871, is of French Renaissance, or rather of its modifications under Henry IV., but carried out consistently; and yet this building also harmonizes well with what is near. It is only now and then, in a great columned building like the theatre at Bordeaux, and the Bourse (Stock Exchange) in Paris, that there seems to be a wholly different style employed, for Gothic buildings are so very unusual in the cities that they do not count at all upon the modern aspect of the town. Much of this tendency in France is due

to the learned character of the criticism there, much less sentimental, much less swayed by general theories of what is right and wrong, far more traditional and kept in place by the social unity which marks French thought. As regards the rest of Europe, the same tendencies are visible which show even more plainly in the United States, to which we must devote the remainder of our space.

Russell Sturgis, F.A.I.A.,
Author of 'Dictionary of Architecture.'

Architecture, American.—The establishment on a firm basis of the present national government at Washington is nearly contemporaneous with the beginning of the 19th century, and before many years had elapsed the Federal buildings in Washington attracted the attention of historians. Congress met in Washington in Nov. 1800, as if with expressed determination to be in session there when the new century should begin. At that time, though the capital city had been for 10 years decided on and its exact location determined, the only buildings which the Federal government found ready for its use were a part of one wing of the Capitol and as yet incomplete buildings for the Treasury Department and War Department. The White House was not yet ready for its proposed use as a residence. Nor did these buildings make very good progress, and when they were burned by the British army in 1813 but little loss was suffered.

After the war with Great Britain, the Capitol was rebuilt rapidly, and completed in its original form, as many men now living remember it, with a low central dome over what were then the wings occupied by the Senate and the House of Representatives. The White House also was finished in its present form, though the completion of the portico lingered for a time. The «Octagon House,» now occupied by the American Institute of Architects, is reputed to have been used by the President during the building of the White House; the building is not octagonal, however, but of an ingenious and unusual plan well calculated to provide an agreeable residence.

Otherwise, throughout the United States there was but little change or development in the line of architectural art. The Georgian epoch of design had passed, except in the construction of dwelling houses. A Greek taste prevailed, and an ambition to produce Grecian architecture was uppermost in the minds of all who undertook public buildings. The lyceums or town halls throughout the country, the city halls and court houses, and State houses or capitols, were generally designed with colonnades. Of this nature is the principal building of the college designed under the auspices of Thomas Jefferson, if not by that statesman himself; of this character is the old custom house (now the Sub-Treasury) in New York, which is a very faithful copy of a hexastyle Doric temple; and of this character are the Nashville State house, the capitol at Montgomery, and a great number of buildings, large and small, in the North as well as in the South, erected at all periods up to the middle of the century. At the same time, however, the dwellings were much more commonly in the grave and decent style which we have generally called «Old Colonial architecture.» In this respect New York city was peculiarly fortunate. Whole quarters of the city were thickly built up with houses of the most satisfactory style which has yet been employed in domestic architecture in the United States — or, at least, which has received general acceptance. Many single blocks or isolated buildings throughout that part of the city which lies south of Bleecker Street still remain in their original condition, and in these is to be seen the original American domestic architecture of the time before 1835. Of the same years are many interesting houses in the New England towns, as well as in Maryland and Virginia. These houses of the 19th century are often confused with the much older houses which are properly «Colonial,» and, indeed, are distinguishable only by the student who will observe the architectural details with some care. The taste for Greek architecture is, it is true, traceable in them in the rather frequent appearance of a colonnade of four or six or, as in one well-known case in Farmington, Conn., of five columns — a nearly unique architectural device. At any time between 1820 and 1850, if a wealthy man wished to build himself a house of unusual stateliness, he would turn the simple domestic «piazza» into a portico of Græco-Roman dignity. Thus in Charleston the Ficken mansion has a hexastyle portico at least as dignified and nearly as large as that of the custom house, and a large mansion on South Battery has a Corinthian portico of four columns serving as its entrance porch. With the years beginning with 1835 the houses of the cities became more often large than handsome, with costly mahogany doors, large rooms divided by colonnades of white-painted wood, and very ample and easy staircases — all of them features known to the country mansions but hardly to city life till that time. Here again New York city is the most important centre of interest, for the houses of Washington Square and those in West 8th Street (Clinton Place), East 9th Street (Brevoort Place), and East 8th Street (St. Mark's Place) are very generally of this type, and never since that time have rows of street houses been so well handled or their interiors so well understood. The houses of Boston at this time were as good internally, and had certain peculiarities of plan recommending them to the student, such as the use of the alley passing through and under the house to the back yard, of the utility of which plan much might be said; but their exteriors were generally less noticeable. The narrow and crooked streets and something in the popular taste almost forbade external display or even elegance. In Philadelphia, on the other hand, severity was caused rather by the strong Quaker influence than by anything in the external character of the town, while the easy access to white marble in considerable quantities made this a favorite material. Hence arose the well-known type of the Philadelphia house, with walls of red brick, white marble lintels, sills, and doorsteps, and, as the houses were built close to the sidewalk, without areas and with the entrance nearly on a level with the street, a display of solid white-painted wooden shutters which carried out the chromic effect to the full.

The cities of the South were less crowded, less busy, more decidedly marked by the distinc-

tion between elegant and humble dwellings. In Mobile, Charleston, and Savannah, the characteristic dwelling was rather a more stately mansion standing free or nearly so, and having broad verandas or "galleries" which, however, were not turned toward the street, but sidewise upon gardens. Savannah, however, has a very unusual plan: a succession of square, open "places" from each of which four streets lead in four directions, giving a series of square corners and allowing of an irregularity of shape in the house-lots which is not known in our other cities. It is a matter of regret that this plan is not preserved in the newer quarters. The residences in Savannah commonly have windows along their sides opening upon a garden, which, if small, is private, made so by brick walls of sufficient height.

The Gothic revival made itself manifest in the United States at an early date. Few carefully designed buildings in the mediæval styles had been built even in England, when, in 1839, Richard Upjohn took charge of the work on Trinity Church in New York, his task there passing almost immediately into the designing of a wholly new structure, which was finished in 1846. At about the same time the Church of the Holy Trinity in Brooklyn, which still stands unaltered, was built by Lefevre, whose name is almost forgotten because of his death soon after the completion of this one important work. These buildings were carefully studied from the English Perpendicular style; and as English Gothic hardly included vaulting as a necessary feature, this was wholly omitted in the American examples, though unfortunate afterthought caused some poor imitations of vaulting in woodwork and plaster. Apart from this the churches were solidly built and with attention to the archæological propriety of every part; the inevitable slips in this direction being caused by the great lack of recorded and accessible knowledge in those pre-archæological days.

No form of Pointed style was in common use for any other buildings than churches; the same architects who did their best to build Gothic churches preferred to design private and business dwellings of different aspect, though there appeared a few buildings which, like Harvard College Library and Yale College Alumni Hall, were reminders of English collegiate Tudor architecture. Upjohn, apart from his Gothic proclivities, was rather famous for his small Italian villas, some of which were of singular grace of design; and A. J. Downing, the landscape gardener, though he occasionally put pointed arches and a steep gable roof to a cottage, carried his Gothic efforts no further than this, and seems to have preferred Elizabethan or some other semi-classic style for the numerous country houses which he designed. The public buildings of the time just preceding the middle of the century (nearly always of pseudo-Greek style, as has been said above) were unimportant, and have been, in the main, replaced by more impressive structures. The country houses were also, as a general thing, without marked character, and the rows of street fronts in New York, Philadelphia, and Boston, and in the newer and rapidly growing cities of the West, were unmarked by architectural intelligence.

In a very few cases a larger house was designed with some faithfulness, preserving a little of the simplicity of the bygone Georgian period, or carefully studied from French Parisian building, or the more tranquil and simple city fronts of Italy. Still, the arrival of the year 1850 found no important architectural movement existing in the country; nor was this year followed by any very marked development. Two or three years later J. Wrey Mould came from England and began to build the Unitarian church in New York at the corner of Fourth Avenue and Twentieth Street. His design included a lofty and slender campanile, which has never been built; and the church was marked by a character of architectural and sculptured detail and by logical solidity of structure that are even now not very familiar to American designers. This, however, was Mould's only great chance; his other buildings were comparatively unimportant, and his work in the adornment of Central Park in New York is undistinguishable from that of other artists employed upon the same terraces and bridges. St. George's Church in New York was completed, except for the spires, in 1853, under the direction of Leopold Eidlitz, who succeeded to his former partner and, perhaps, the first designer of the church. This church has since been injured by fire, and altered; but the original scheme, with an undivided and unbroken interior, and a roof supported by carefully designed timber trusses of two patterns, alternating one with another, was one of the boldest and most satisfactory buildings in the United States. The spires were built by Mr. Eidlitz a few years later, and were remarkable as the only pierced spires of Romanesque design known to students; but, unfortunately, the poor quality of the stone caused their removal. The above-mentioned buildings had architectural character, but the greater part of even the respectable and useful structures of the time were comparatively devoid of it. The Boston Athenæum, with its good plan and really excellent reading room; the New York Astor Library, the Boston Public Library on Boylston Street, finished about 1858, and some smaller buildings which the Eastern cities managed to pay for during the decade from 1845 to 1855, were generally as devoid of individuality as were the stone-faced hotels and State houses of the time. During the years from 1845 to 1860 the building of the Southern cities and their immediate neighborhood was carried on much in their old lines — the lines of the Georgian architecture. What deviation there was from this was still rather in the direction of the supplying of obvious needs. Thus, the houses of Beaufort and of other seaside summer resorts were not unlike English Georgian manor houses, with this peculiarity, that they were large with a few spacious, open rooms and wide halls, giving the idea of small and simple English manor houses increased in scale — a scheme very appropriate to the low latitude and the steadily warm summer weather. New Orleans, most conservative of American cities, showed no change in its outward aspect. The Western cities had received the inoculation of the very evil system of irrational ornamentation which marked also the buildings of the East, as will be stated farther on.

About 1855, Richard Morris Hunt, having returned from Paris, where he had been a student and also assistant to a prominent Paris architect, built the Studio building in West 10th Street, and the since-destroyed private house on the north side of West 38th Street, putting into these something of that French completeness of plan and of exterior disposition of parts which the country had hardly known before. Hunt also established an atelier on the Paris plan; and half a dozen of the architects most successful and most reputed between 1870 and the close of the century were for a time inmates of that studio. Experiments were tried in those days — experiments both in material and design — which it is sad to see were wholly abandoned during the years which followed. Thus, when Upjohn built Trinity Building in New York, a business building, a mere investment for Trinity parish, he used terra-cotta for the cornice, and by this means obtained a boldness of overhang which he would hardly have dared to give in stone. Terra-cotta had to be imported in those days, or, if not imported, then made by means of a special plant and fired in furnaces erected for the occasion. It is easy to see why the experiment had no immediate results. So in design the churches on Fifth Avenue — that of the Ascension, at the corner of 10th Street, and the Presbyterian church 300 feet farther north, together with the church at University Place and 10th Street — were all of about this period, and in them was more intelligent designing than generally in the civic buildings of the time; but there was room for more originality in the latter, and the buildings by Hunt above named and a bank in Wall Street by Detlef Lienau held out more promise. Other business buildings of great importance date from this time; two of them were built by Eidlitz in the business section of New York, both of singular solidity and of thoughtful design, which cannot now be judged, as one has disappeared and the other has been altered out of recognition.

The war came, and while some important enterprises took form during those four years of excitement and rapid thought, but little of importance was brought to perfection. The conditions were peculiar; many of the architects and many of their possible employers were in the army; but those who were at home, although often for a short visit only, were full of ambition. So it happened that both industrially and artistically the years immediately following the war were very active. In the Eastern cities, the domain of business began to encroach rapidly upon that which had been the residence portion, and whole streets were built up with buildings of somewhat pretentious character as to their outsides, the masons and stone-cutters making fortunes out of the simpler work upon so many precisely similar fronts; the residence streets were lined with buildings of constantly increasing cost, and also the construction of country houses became an important employment for the builders in the smaller towns. A few years were still to elapse before the more important public and private buildings took shape; this was the epoch of much building of less pretension.

The result of the mingling of styles and the clashing of different tastes and fancies was very curious. Philadelphia buildings kept nearer to their old type of red brick and white marble and simple design; Boston buildings were far more often designed by architects employed, each one for a separate building by the owner of the soil. New York, following its unfortunately deeply-rooted habit, built itself up in long rows of stores and houses, each for sale to any possible buyer, and therefore of necessity deprived of individual character. And yet the difference in architectural merit of the buildings in the three cities was not so great as might be assumed. The critical students of 1865 abhorred the New York brownstone front, with its high stoop and its exaggerated affectation of Corinthian elegance, and they envied Boston her intelligent Harvard graduates who owned lots and would build houses for themselves, and who employed other Harvard graduates to design those houses. But Philadelphia and New York, sticking to their traditions, produced at least less that was monstrous and impossible than Boston. There was more intelligence in the Boston buildings, but there was also more whim. The dreadful heresy of eclecticism got hold of a few of the Boston men, and the Gothic buttress topped by an Ionic pilaster, a motive which passed into a proverb, was only an extreme case of what was a serious injury to architectural growth. The Gothic revival in the hands of Peter B. Wright, J. Cleveland Cady, Calvert Vaux, Frederick Clarke Withers, and John Sturgis, led to the erection of some important buildings; the Boston Museum of Fine Arts, fronting on Copley Square, being the most florid of these, and embodying the English terra-cotta building of the day. The Academy of Design in New York was the only building ever erected in America in which a serious effort was made to design an abundant sculpturesque decoration on the principles of the more advanced preachers of the gospel of mediævalism. The labor and thought required for such work prevented any immediate following of this example, and it soon appeared that the taste for Gothic buildings was not deeply rooted among the architectural students of the time. Good buildings were designed by the men who have been named, and Richard Upjohn's admirable Trinity Chapel should be added to the list of Gothic churches deserving special praise; but the general effect of the taste for pointed windows and for the ornamentation supposed to belong to them was very unfortunate. It had much to do with what was certainly the most unsatisfactory epoch in American architectural designing. The years from 1865 to 1875 saw the erection by the hundred of the most insufferable country houses that could be imagined. All architectural sense seemed to have gone out of the designers. The posts of the verandas were cut into shapes suggested by nothing in the world except children's toys; window-heads of hitherto unknown form were put into woodwork, into cast-iron, and even into stone; a variety of roof known throughout the country as the French roof, and consisting of a lower slope so steep as to be almost a vertical wall, and an upper slope so flat as to be a mere "deck," produced the ugliest skylines conceivable. The country was full of carpenters and masons who thought themselves architects because they had purchased and studied some book containing plans and elevations of famous buildings. These men were trying

"FLATIRON" BUILDING, NEW YORK, IN COURSE OF CONSTRUCTION.

"FLATIRON" BUILDING, NEW YORK.

for originality; but this search, difficult and dangerous even among men who have had previous training in artistic designing, becomes ruinous when followed by the men of an epoch and a country as devoid of artistic sense as those which we are now considering. Buildings were planned without any artistic perception of the necessities of the plan; a room was thrust out to the east and another to the south and another to the west, these different wings having no relation to one another or to the central mass, which, indeed, they might entirely conceal or even destroy.

The same incongruity of design affected even the public buildings of the time. These were the days of Harvard Memorial Hall, of the first and accepted design for the capitol at Albany, of the United States government buildings, including the post-office and court rooms in the same huge mass, which were erected in many of the cities of the land, and of very numerous buildings which the designers, if now living, would with perfect propriety disclaim, classing them as the work of their salad days. Men who have since proved themselves capable of much better things produced the most unfortunate designs during those hurried years. The *Tribune* building in New York, the Boston city hall and court house, the earlier public buildings of Chicago, the Connecticut State house or capitol at Hartford, may all be named with those cited above as specimens of what ought not to be done in architecture, and yet as the buildings of men who have since proved themselves capable and dexterous. It is, indeed, true that a flood of bad taste covered the land, and that few detached monuments of some little architectural merit could be seen above it.

A more promising condition of things was seen to exist when the third quarter of the century was completed. In 1875 the older men who were still busy had learned a great deal by experience and by their own blunders; the younger men began to come in, more or less well taught in Paris — at all events certain of the fact that there was such a thing as 19th-century architecture and that as yet the United States had hardly achieved it. Henry Richardson was busy as early as 1875, and a very few years later he took up definitely that Romanesque style which he had studied in central France — took it up, and built thereafter according to its doctrine, without forsaking it for a moment. Trinity Church in Boston, partly studied from Spanish models, was one of his Romanesque buildings — perhaps the earliest of them. Nearly contemporaneous with this were three important churches in Boston, one of them by Richardson himself, the others by the younger Upjohn and Cummings and Sears; and several large churches of considerable merit were built in different mediæval styles in New York. The older Upjohn, the designer of Trinity Church 35 years before, made of St. Thomas's Church, when rebuilt on Fifth Avenue, his crowning labor. The present writer built many college buildings between 1870 and 1880, and, in connection with George Fletcher Babb, built Battell Chapel of Yale College and a bank building in Albany, each of these in a modified Gothic style. Other college buildings, by George B. Post for Princeton College, by H. H. Richardson for Harvard University, and by J. Cleveland Cady in several parts of the country, assisted greatly the advance of style; and Trinity College, near Hartford, was begun on a great scale and in a consistent English Gothic style from the designs of William Burges of London. The admirable buildings of Columbia College at 49th Street, New York, were built by C. C. Haight at a later time, and the same architect built theological seminaries and hospitals in and near New York, all in some form of English Collegiate Gothic. Of younger men, the firm of McKim, Mead & White, who had built the large and interesting buildings known as the Tiffany house and the Villard-Reid house in New York, designed also the Newport Casino, and in doing this helped much toward a development of country house architecture which, indeed, has constituted the most important artistic result of the quarter century. The American frame house, sheathed with clapboards or shingles, is, in the hands of architects of taste, the best thing we have yet to show. A few years later the firm of Carrère & Hastings designed the spirited Spanish-looking palaces used as hotels in St. Augustine. All these buildings had character; but there were still traces enough of the old unarchitectural designing, and this especially in the more important buildings, as is natural. The original designs for the Albany capitol and for the Philadelphia public buildings were nearly as devoid of architectural merit as if they had been built 40 years earlier.

Since 1885 there have been many more buildings of cost and of great pretension — many more buildings which in scale reached the standard set by the continental nations of Europe — than at any previous time. Club houses of great importance, dwellings of such cost and dignity that they are really and in every sense of the word palaces, and national and municipal buildings, into the design of which some architectural ambition has found its way, are now so common that even a bare list of them would fill more space than can here be given. If the progress of architecture since that time has not been all that could be hoped, this fact is to be ascribed to the rapid increase of new demands upon the architect's attention. New problems have developed themselves much more rapidly than the comparatively small number of intelligent architects could work them out. The common use of the elevator made 10-story buildings as easy to administer as the four-story buildings of old time, and the hotels and business buildings were at once changed in this radical way; whereupon it was found that the design which had served for a four-story building was not capable of ready adaptation to the new conditions.

Hardly had this been realized and the problem fairly got in hand when the introduction of the steel-cage form of construction revolutionized anew half the building of the American world, and the 10-story front had to be reconsidered for 16, 18, or 20 stories. Moreover, while the 10-story building, like its predecessors, had been a structure of solid walls, carrying iron-framed floors, the steel-cage building was felt to be a totally different construction. Here was a skeleton of uprights and horizontals, and no thoughtful architect could jacket such a structure with a thin stone-faced or brick-and-stone-faced wall without feeling that this was a mere simulacrum of building and that the real secret

of the new design had not yet been discovered. So, too, with the churches, although they were not required to be of unusual height, and although the steel-frame structure hardly suggested itself as fit for them, their condition was felt to be changed by the monstrous height of their neighbors, the insurance buildings, the hotels, the apartment houses. A church with a 200-foot steeple and a 70-foot high roof-ridge made but a poor show alongside of a tower-like mass as large horizontally at top as at bottom, and carrying a level cornice higher than the steeple-cross of the church. Moreover the architects whose work was of such quality as to please greatly the more instructed part of the community — a community full of a kind of literary intelligence, but without much training in the arts which address themselves to the eye — those architects found themselves overwhelmed with work. It is not in human nature to refuse a $20,000 or $40,000 commission; it is not in human nature to confess the impossibility of doing so much work and doing it well. The result is a general tendency toward a method of design which, in the best instances, is markedly controlled by good taste, by the abstention from incongruities and ill-considered details, but which may be almost devoid of the evidences of thought. The colonnade taken bodily from an ancient building, or a theoretical plate in an old book, the evenly spaced windows capped by a little delicate sculpture, the roof either invisible or of low pitch and masked by a balustrade copied from an Italian palazzo — these and other such architectural members are united without shock and without repulsive incongruity in buildings which do their appointed work quite well — which accommodate a family or a congregation, or which prove to be paying investments — and the community is fairly well satisfied. The extreme rarity of anything novel in design goes with this abrupt explanation of our present state as an architectural community. Louis Sullivan of Chicago is left alone in his serious and repeated efforts to design the exteriors of lofty steel-framed buildings according to their nature and the requirement of the law and modern custom. A. Page Brown, recently dead, was alone in having a separate and little-known national style in which to build his California College buildings. Heins and La Farge are almost alone in having a large church (the Cathedral of St. John the Divine) put into their hands to be slowly elaborated and perfected in design, even as the preparatory work progresses. Shepley, Rutan, and Coolidge of Boston are almost alone in having a chance to build a costly and massive structure (the west portal of Trinity Church), with an abundance of representative and ideal figure sculpture forming an essential part of the architectural design. Wilson Eyre has few to help him in his gallant effort to create a truly decorative system of sculpture for buildings which can have but little of it. Sculpture is, indeed, added to a few of our buildings of neoclassic design, just as mural painting is used within, but this without modifying the architectural character of the structure.

The conclusion seems to be that while the artistic mind of the country has well outgrown the period of callow haste and of ill-bred ugliness, it has hardly as yet entered upon a true architectural progress. The possibilities of such progress are evident; moreover, there are artists enough who feel the need of it; but whether the mind of the community, giving its best energies to money-making, will in the course of the next century apply itself with serious purpose to architectural art is, perhaps, as uncertain now as it was in 1850.

RUSSELL STURGIS, F.A.I.A.,
Author of 'Dictionary of Architecture.'

Architecture of Transition, that which shows somewhat rapid change from one important style to another. Strictly speaking, the architecture of all periods before the wars of the French Revolution was continually in a state of transition, though since that time it has been influenced rather by sudden attempts at reviving styles long since forgotten. A natural transition was always going on; but there were epochs when the changes in progress were of a specially radical character. Such a time was that when the more stately architecture of the city of Rome and those towns and lands which depended upon it, was undergoing a change from the columnar character given it by the Greeks, to the vaulted and arcuated character resulting from the introduction of Eastern methods into Italy. This subject is treated in the general article ARCHITECTURE, and under ROMAN EMPIRE, ART OF; but it may be pointed out that the exact time of the transition cannot be fixed. The famous Pantheon in Rome, a round building of immense solidity roofed by a cupola, hemispherical as seen from within, but low as seen from without, was long supposed the earliest specimen of solid masonry building. The walls and the dome alike were built of rubblestone laid in strong cement mortar, but without much reference to the curvature of the vault or the preparation for the different openings — doors, windows, archways. These were built up and the building outlined in the first place, by means of brickwork of very hard and perfect material and workmanship; then the great weight of the wall and vault was added, and the resulting building, with rough surfaces of stone and mortar without comely or orderly arrangement, was faced up, finally, with stucco or with slabs of marble within and without, and according to the place of each member in the completed building. The Greek columnar system, and especially the Corinthian order, was used as pure ornament, and for the interior alone; the marble columns carried no weight except that of the slight entablature put in place merely to complete the order and to give a finished architectural look to the whole. This building was long supposed to be the historically celebrated Pantheon of Agrippa, and to have been built during the principality of Augustus about 25 B.C. It is now known that only the portico can be of that time and that the round building dates from the reign of Hadrian and is of about 120 A.D. We have no knowledge as to the chronological order of other early buildings of the same character. The thermæ at Caracalla were built about 215 A.D., the thermæ of Diocletian about 290 A.D., the basilica of Maxentius and Constantine about 310–20 A.D.; and all these buildings have their great halls vaulted with groined vaulting as massive as the cupola of the Pantheon and built of masonry in a similar fashion. No one can fix the beginning of this system, nor is it possible to say what buildings in the Oriental

provinces of the empire gave rise to the new structure. Etruscan example can hardly be thought very influential in this. It has been suggested that the lost architecture, at Alexandria and other great towns of the East of the time of the successors of Alexander the Great, would, if it could be explored, reveal this secret. All that we can say is that the chief buildings of the empire from about 100 A.D. until the fall of the western empire in 475 A.D. were vaulted structures adorned by pseudo-Greek columns and pilasters, grouped in screens or used in couples or singly as apparent support for the vaulted structure, and the surfaces of masonry adorned with marble or with stucco in figured bas-relief, and with painting and gilding.

It is possible, however, to mark out the close of this period of transition. The palace of Diocletian at Salona, where now is the town of Spalato, was built after 305 A.D., and that building is Romanesque in its character. This means that here are seen arches springing from the capitals of columns, exactly as they were to be built during the next 1,200 years, without the necessary interposition of the classical entablature. It means also that the classical ordonnance and proportions, inherited from the Greek artists 600 years before, had finally lost their hold. Buildings of the same epoch and others a little later in Syria, are of even less classical character, and even more decidedly Romanesque (see CHRISTIAN ARCHITECTURE). The recently explored ruins in North Africa are frequently of the same style of design, with completely Romanesque treatment of arch and abutment. This character is seen, too, in buildings as early as the Arch of Hadrian at Athens, and the arches at the two ends of the famous bridge at Saint Chamas in southern France. In each of these the great arch springing from the abutment on either side is not in any way subordinated to a pair of columns or a pair of pilasters; columns are used, indeed, but only to adorn the outer edge of the piece of walling, in much the same way as the angle shaft of the 12th and 13th centuries was to be used. Now, this early Romanesque of the 4th and 5th centuries is the organized style to which the great thermæ and basilicas named above are the transition. The building first named above, the Pantheon, may be taken as a type of this transitional architecture.

An interesting art of transition is that which marks the growth of the Gothic style out of the Romanesque. The date of this may be set at 1150–70 A.D. and the place as northern France — the country around Paris. In some of the provinces buildings even later than 1170 appear as transitional, for it took a quarter of a century before the people of the Rhine, of northern Spain, or, indeed, of the far south of France, had fully absorbed the new ideas of building. The famous Church of S. Remi at Reims may be looked upon as a type of this transitional architecture, and large parts of the still better known Church of S. Denis near Paris are of this character. These are the buildings in which the ribbed vault has been adopted once for all, and the pointed arch with it, as an almost necessary part of the actual structure, but where the round arch is still used for many of the openings in the walls and where the flying buttress is as yet far from complete.

The most important style of all those which may be called Transitional is that of the close of the Gothic epoch. The Hundred Years War in France and Flanders came to an end about 1435. There had been but little important work done on the continent during the 14th century, but in England the very curious Perpendicular style was developed, one in which the mullions of the windows were carried through until they nearly met the intrados of the arch above, so that the windows seemed divided up into series of vertical panels almost unbroken from top to bottom. The churches in this style are known by their very low roofs, nearly flat, so that they do not show above whatever little parapets may be erected upon the wall. The towers are square and generally flat-topped, with very seldom any spire or lantern and with pinnacles at the four corners. This style was continued into the period of which we now have to treat; and the transitional art in England, reaching even to the accession of Elizabeth (1558), is Perpendicular in its general character. Very different was the Florid Gothic of northern France. The Church of Notre Dame de l'Épine near Châlons-sur-Marne, and that of S. Jacques des Vignes et Soissons (ruined) are of this style, but are not its best specimens. For the full beauty of the style which we call Flamboyant, we must go to the Cathedral of Evreux and that of Narbonne. The beautiful tower of Saint-Pol-de-Leon, the great churches of S. Wulfram at Abbeville and S. Maclou at Rouen, the still more characteristic church at Saint Riquier, the west front of the Cathedral of Tours — all these are the faultless buildings of the Flamboyant style. They date from the years between 1450 and 1500; but the style continues into the 16th century. Parts of the Church of S. Maclou, named above, are as late as 1535, and that is about the date of the Palais de Justice, in the same town. The south transept of Beauvais Cathedral may be even later than this, and the famous Church of Brou near Macon in Burgundy of the years 1510–36. The reader must constantly recall the fact that during these years the classical revival in Italy was at its very height (see ARCHITECTURE and RENAISSANCE). The strange thing is the complete rejection or ignoring of the classical feeling by the northerner, the complete adoption of it south of the Alps.

The Flamboyant Gothic is not as strictly logical as the true Gothic of the 13th century, though the interior of a great church like one of those named above is apt to be as straightforwardly built and as sincerely designed as at any epoch. The change is most marked in a certain fantastical character given to the unconstructional part, the window tracery, the parapet, and the sculpture; but in England the extraordinary fan-vaulting, first seen in the cloisters of Gloucester Cathedral, but carried on in the Divinity School at Oxford (1450) and in the Beauchamp Chapel, Warwick (1460), reached its culmination in the three famous buildings which we always think of when fan-vaulting is named. These are the Chapel of S. George at Windsor Castle, the Chapel of Henry VII. at Westminster Abbey, and, the most perfect of all, the magnificent Chapel of King's College at Cambridge, finished about 1510 and embodying in itself nearly all that the Florid

architecture of England has to show. The interior is one unbroken hall lighted by huge windows on both sides, and by still larger windows at the two ends. It is 78 feet high inside, a considerable height for an English church; about 45 feet wide and about 315 feet in length; so that it has the characteristics of the best English interiors — great length as compared with height and width. The proportions are of extraordinary beauty, and there is in no place outside of France a more splendid ecclesiastical interior.

This fine Late Gothic of England passed into the architecture which we call Tudor, from the Tudor sovereigns, Henry VII. and his successors. Of this the most interesting development is that which we call the Elizabethan style, best known in the splendid country houses which were built during Elizabeth's reign in different parts of England. The architecture of some great college buildings in Oxford and in Cambridge is also of this character,— with low (four-centred), pointed arches, and generally with low-pitched roofs; but these roofs are often splendidly designed within, with elaborate timber-work forming a design even more varied and rich than the vaulting of the continent. Classical details, columned porches, and the like, were introduced from Italy, and many of the otherwise picturesque and semi-Gothic houses of the period have these curious "Italianate" features. This architecture continued into the reign of James I. and disappeared in the political confusion of the time, to be succeeded by a classical style brought fresh from Italy when the conditions which ensued allowed of costly building once again.

The Florid Gothic of France and the neighboring countries of the continent is accepted by the French writers as a part of the northern Renaissance; but we have to separate it very carefully from the Risorgimento or classical revival beginning in Italy about 1420. The reign of Louis XII. in France (1498–1515) is the time when we see, struggling with one another in the North, the classical influence from Italy, then nearly a century old in the land of its origin, and the Florid Gothic of France. Thus, at the famous Château of Blois, the wing named after Louis XII. is literally half way between Gothic and classical. Arches are three-centred and therefore without points; pillars are either round or square in section, with paneled sides, or, as at the great driveway of entrance, are combinations of square and round forms; and all these pillars have fully organized capitals of semi-classical character; but the roof is steep and is adorned with high chimneys and very elaborate dormer windows, and the design is picturesque rather than symmetrical. A square tower stands at either end of this building, of Louis XII., and each of these towers remains rather Gothic than classical to the hasty observer, although the avoidance of the chief forms of Gothic art is very marked. Almost adjoining this stretch of building is the front named after Francis I. and built only 25 years later than the building described above. This is not Gothic at all. The windows are all square and the walls have pilasters in regular ordonnance, while yet the lofty roof, the picturesque dormers, and the high chimneys remain to express the transitional character of the whole. The Church of Brou, already mentioned, is exceptionally late for a building which is entirely Gothic in style, without classical motives of any sort.

Russell Sturgis.

Architecture, Education in. *Training.*— The ideal architect is an artist who employs structure as his medium of expression,— whose function it is to produce beautiful buildings.

That this ideal is realized by relatively few of those who are called architects in our day is due to the fact that its embodiment under modern conditions involves the correlation of activities of very diverse nature; and few there are who display in just proportion the capacities these diverse activities involve. These may be placed in three great groups, and the architect's training may be correspondingly considered under three headings, namely, his artistic education, his technical education, his business education.

The student who hopes to be an artist-architect must train himself somewhat as do all artists in all other fields. Yet he cannot with his own hands bring into existence the building his imagination pictures; he is compelled as no other artist is, to rely upon the work of others in the realization of his artistic creations. Hence it becomes very important for him to gain a very special technical training in order (1) that he may learn how to indicate to his artisan helpers the nature of the work to be done, and (2) that he may become acquainted with the methods proper to these artisans in the accomplishment of their several tasks.

But beyond this the architect who would reach the highest goal should prepare himself for a business career. For unlike other artists he is usually unable to express himself in his chosen medium unless others entrust to him the expenditure of large sums of money. And if he is to be thus trusted he must exhibit executive ability, a knowledge of men and capacity to manage them, and at the same time he must possess unquestioned reliability and business sagacity.

In this connection it may perhaps be well to note that in our time there are not a few men who are counted as successful architects who are really merely good business men working in a special field, men without high artistic ideals or susceptibilities, and who gain such success as they attain by the mere direction of hired designers, and by the careful management of the business of their clients. The education of such men involves only such general training as is required by other business men, with the addition of such studies as will give them a knowledge of the architectural forms current in our time, and such a superficial acquaintance with the principles of architectural design as will enable them to choose as employees designers whose work will satisfy the average taste of their clients.

We need not concern ourselves, however, with business men of this type, for they will not be looked upon as architects by those to follow us unless they combine with their business skill the other qualities demanded of the ideal architect, to the consideration of whose training we may now turn our attention.

Apprentice System.—As is indicated by the etymology of his name, the architect was originally a master workman; one who had arisen from the ranks because he had evinced skill and imagination in guiding the construction of buildings after the methods current in his time, and who through the exercise of this skill and imagination had produced buildings which were looked upon as beautiful by his fellows.

The methods employed by the architects of antiquity are little known to us, yet as the work under their control became more complicated they must have found it necessary to employ assistants who at first were without doubt merely trade apprentices, and from among these the architects of the next generation would most naturally be chosen.

In modern times, as the use of complicated drawings has become more and more important, the architect has found it necessary to use his assistants on special work which does not involve the skill acquired by artisans in construction; and thus the type of man serving as the architect's apprentice has changed. While not an artisan himself he has learned his master's methods, and presently we find men thus trained assuming the function of the architect without any preliminary practice as constructors.

The apprentice system of education for the architect as thus developed was not unlike that adopted in the earlier days in the training of artists in other fields, and with such modifications as are natural in relation to the complexity of modern life it has persisted even to our day in many lands. In England a large proportion of the eminent architects of the day have been educated in this manner, and until within a generation in this country no other system of training for the architect was available.

A similar apprentice system obtained in the training of lawyers and doctors until a late period when special schools of law and medicine became established. The success of these schools called attention to the fact that, from a certain point of view, the architect is as clearly a professional man as the doctor or lawyer, and that the weaknesses in the training of doctors and lawyers under the apprentice system, which had led to the establishment of their special schools, existed also in connection with the study of architecture.

These weaknesses need but to be stated to be apparent to all. Evidently the teaching a busy architect can give to his pupil must vary greatly in quality and amount as the demands of his practice vary. Evidently his teaching is likely to be unsystematic; and it is certain to be biased by his individual taste, a matter which is of importance in relation to certain subjects, to be referred to below, where the broadest catholicity is of importance.

Thus following the example set in other professions, there have been established schools of architecture in which an effort is made to give the student a systematic training which shall not vary in quality and amount from year to year, and which shall avoid the unfortunate influences which are liable to obtain under the apprentice system. It will be generally conceded that the schools as a rule have been reasonably successful in this effort, if general results are considered, if particular instances are not over emphasized.

But the abandonment of the apprentice system of training in the law and medicine carried with it a loss which was generally overlooked. The newer method tended to minimize if not to eliminate the inspiration which comes to the student as the result of contact with the living master in the active practice of his profession. Nowadays students in law and medicine appreciate this loss and are supplementing their school training with practice under the guidance of men of reputation in their special fields.

But the loss to the student of architecture who fails to come under the influence of a practising master can scarcely be overstated. For the artist such an influence is of vital importance; under it he will absorb, as it were, stores of lore peculiar to his art which can never be expressed in the alien words of the lecturer, or upon the pages of a text-book. Fortunately the architects themselves are beginning to see that in one way or another the architectural student must be brought to feel this influence. What was valuable in the apprentice method of education, and has been in many cases lost, must be regained. In no inconsiderable measure it has been regained in the atelier system as developed in the Ecole des Beaux Arts in Paris, and fortunately a distinct movement in the same direction is noted in the later developments of the schools existing in this country.

Granting then that there is a vital something of supreme importance to the architectural student which the school training cannot give, let us ask what he can gain in the schools, with economy of his time and labor, in connection with the training which we have seen to be desirable in the three directions above spoken of, which for convenience we shall treat in reverse order.

Business Training.—The architect's business training cannot be materially advanced in the architectural school. The general education, and the influences which produce the reliable, accurate, and farseeing business man, can best be gained quite apart from the school course, in the practising architect's studio. In this connection it may be noted that, while the artistic side of the architect's life must always be first considered, it is easy to underestimate the importance of his business career. The student fresh from the schools too often thinks that he may at once undertake important commissions without the business experience which a long established practice brings. He will tell you that this can be purchased ready made by the employment of others to attend to this drudgery so repugnant to a man of artistic temperament.

But in this view there lurks a hidden danger to the art of architecture itself. As has been said above, the confidence of the client must be obtained by the man who is to spend the client's money, and if the skilled designer is not one who inspires this confidence the control of great constructions will surely go to men of less artistic ability, and the skilled designer will find himself directed, rather than the director of the work necessary to the embodiment in solid form of the ideas which his imagination creates. Nothing can be more dangerous to pro-

gress in architecture as an art than the establishment of a belief that the architect's function ends with the creation of designs on paper; his art product is in the constructed building, and if effective artistic result is to be gained he should actually direct the construction in all particulars and to the very end, and should train himself to assume all the labor and responsibilities this direction involves.

Technical Training.—We may now turn to the consideration of the architect's technical training, which in the first place must result in the mastery of methods of representing his conceptions so that they may be understood by his clients, and comprehended by the workmen who are to be employed to embody them in material form. This means in the main the attainment of skill in technical draughting; and this can very clearly be better and more quickly gained by the concentrated effort possible in a school than in the course of the routine work in an architect's office. The student should be warned, however, that a danger is connected with the attainment of this skill if he comes to look upon his drawings, which are no more than tools of his trade, as works of art in themselves; for these drawings are necessarily on plane surfaces, and if he gives too much thought to their perfection he is liable to overlook the importance for him as an architect of thinking in solid dimensions.

The general principles governing the representation of details of, and the writing of specifications descriptive of, the work to be done can also be learned in the schools, but little more than these general principles; the student must not hope to gain facility in these important matters without the experience of actual office practice.

Artistic Training.— It is true of all artists, as it is of poets in particular, that they are born and not made; and surely unless all opportunity is lacking the born architect of genius will show his power whatever his training may be. Nevertheless there are certain matters which even the genius must learn by his own often bitter experience, or else from those who have practised his art before him; and these matters may in some particulars be learned most quickly and surely in a school. It will be agreed for instance that each artist should understand well the nature of the medium in which he is to express his measure of genius. The medium of the artist-architect is construction in masonry, in iron, and in wood; and a thorough knowledge of the principles of construction is most important to his progress. This knowledge is the ground work of engineering, and clearly can best be gained in a school. In relation to this special study it may be said, on the one hand, that the most thorough training in engineering cannot injure an architect provided it does not take from the time to be given to other equally important matters to be referred to below. On the other hand it must not be forgotten that the architect's function is not merely building as such, but building in a manner that shall stimulate in his fellows the sense of beauty. This molding of constructional forms into shapes which are beautiful is a matter of difficulty which has been attained by architects in the past only through numberless trials, with their failures and successes; through the elimination of the ugly, and the repetition with ever increasing improvement of that which has shown itself to be pleasing. The architect has thus always worked with, and upon, established modes of construction, and he always will; and this distinguishes his work from that of the engineer, whose function it is to devise special modes of structure to meet special structural demands. It is apparent then that the training of the architect in relation to his structural medium differs from that to be given to the engineer, in that the architect does not need to gain more than a thorough understanding of the principles of structure which he is to use in his work, and this does not necessarily involve so prolonged or detailed a study of the sciences as is needful for the engineer.

The Architect as a Designer.— We may now turn to the consideration of what is of the highest importance to the architect, namely, his training as a designer. As we have suggested above, no amount of training can give to a man that measure of genius which constitutes him an artist. None the less the greatest genius will gain much if he learn the lessons taught by the experience of the masters of the past, and the man who is less than a genius were stupid if he did not welcome this teaching. The masters of architecture of the past have left us a record of the forms and relations of parts which after long series of studies and experiments they have found to be most beautiful. This record is not found in written word, but in the great monuments which have been left to us; and the study of these monuments after a certain method constitutes the history of architecture. The student should gain as thorough a knowledge as possible of this history, with especial reference to the vital development of the various greater and lesser styles, giving particular attention to those forms in which the highest perfection has been attained in the past, and making a special study of those forms which appeal to him as most likely to be of service to him under the conditions which surround him. He should also gain a considerable acquaintance with the other arts, especially with those most closely related with architecture, namely, sculpture and painting.

Evidently a large part of the information just referred to can be gained through text-books and illustrated lectures given in the schools. But as clearly is it important for the architect to study the art products themselves, and this can only be done satisfactorily by travel in the Old World, where the great architectural monuments of the past exist. Where such travel is impossible, he may gain something approximating to it by studying such models of masterpieces of the past as are available in museums, and by the thoughtful use of photographs of existing masterpieces.

In all this, however, the student will have been merely sharpening his tools for his life work; all this is but preliminary to practice in design. Here he cannot properly content himself with mere study of the works of other masters. For the conditions under which each generation works are always in some respects new, and architecture as exemplified in his work can only be a living art if the architect, while taking advantage of the artistic experi-

ence of those who have preceded him, builds to meet the new conditions in which he finds himself placed.

In these studies in design he will necessarily employ drawings very largely, but he should never allow himself to forget that these drawings are merely symbols of the art product he aims to produce; he should use every effort to avoid thinking of his design on paper as the end of his endeavor; he should strenuously train himself while he works on a plane surface to translate into the actual material substance of the building he is projecting; that is, to design and think in the solid. To this end the student should give considerable attention to modeling in clay, and he will find it most valuable to cultivate the habit of rapid and accurate sketching in perspective, and to acquire deftness in making simple small scale clay models of his *projets.*

It is in connection with this study of design that the architectural student will find it to his greatest advantage to work under the inspiring influence of a practising architect whom he recognizes as a master of his art; and it is most encouraging to note, as has been remarked above, that those who guide the best of our modern architectural schools are recognizing this fact, and are aiming in one way or another to regain the benefit to the student in this regard which was connected with the old apprentice system so carelessly laid aside in most of the schools as first established.

It must be apparent to the reader of what has preceded this that no student should undertake the practice of architecture without facing the fact that he has before him a long road, and a life of arduous effort. In the view of the writer no young man should undertake this work unless he feels within him a very powerful inclination to it. The modern world is all too full of those who choose the architect's life because they think it relatively easy and especially delightful. The latter it surely is; but the former it as surely never is.

Conclusions.— The conclusions reached may now be summarized in a few words. Beyond such general culture as he may be able to gain, the most desirable special training for an architectural student will be given by certain studies which can best be taken in established architectural schools, supplemented by careful observations of monuments of architecture in the course of travel in Europe, and by work in the studio and business office of a skilled practitioner who is a masterful artist.

It were well if life were so ordered that the acquisition of technical facility, and the study of design under a master, could begin in early youth, and continuing could fill the leisure hours of the student while gathering the store of general information which tends to broaden his life; but under existing conditions such an order of work is difficult to arrange.

If choice is to be made among the architectural schools, the one chosen should if possible be one situated in a city where building operations are proceeding on a large scale, and especially one in which design is taught by masters of architecture who are in active practice.

Finally the student would do well who could manage to obtain a position in the draughting room and business office of some architect in active practice during a large proportion of the long school vacations so generally given during the summer season. See PAINTING, EDUCATION IN; SCULPTURE, EDUCATION IN.

HENRY RUTGERS MARSHALL.

Architrave, är'kĭ-trāv, in classical architecture and imitations of it, the part of an entablature which rests immediately on the heads of the columns, being the lowest of its three principal divisions; also the molded enrichment on the faces of the jambs and lintels of a doorway or window, this being a part of the entablature carried around the opening and mitred at the upper corners.

Archives, är'kīvz (Latin *archivum*), a room or building in which are kept the records, charters, and other papers belonging to any State, community, or family. Very frequently the name is applied to the documents themselves. The archives of the United States are now superintended by the heads of departments.

Archivolt, är'kĭ-vōlt, in architecture, the ornamental band, often of moldings, on the face of an arch and following its contour.

Arch of Con'stantine. See ARCH, MEMORIAL.

Arch of Septi'mius Seve'rus. See ARCH, MEMORIAL.

Arch of Ti'tus. See ARCH, MEMORIAL.

Arch of Tra'jan. See ARCH, MEMORIAL.

Archons, är'kŏnz, the highest magistrates in Athens. There was for a long period only one archon, who possessed for life all the power and dignity of a king, and was chosen from the royal race of Codrus. In 752 B.C. a change was introduced, and the tenure of the archonship was restricted to 10 years, the person appointed being still a member of the royal race. In 714 the latter condition was abolished, and the archonship thrown open to all the Eupatrids or nobles; and in 683 a still greater change was introduced, the office being now made annual, and its functions distributed among a body of nine. The reforms of Solon threw the archonship open to all who possessed a certain amount of property, whether noble by birth or not; and in 477 Aristides made it accessible to all Athenian citizens, without distinction. Until 508 the mode of election was by suffrage of the nobles; election by lot was then introduced, and the person elected had to undergo a scrutiny before the senate and before the Agora in order to show that his ancestors had been citizens for three generations, and had to swear to obey the laws. The first of the nine archons was called "the archon," and sometimes the Archon Eponymus, because he gave his name to the year in all public records. He had the care of minors and orphans, and had to superintend some of the festivals. The second archon was called the King Archon. Upon him chiefly devolved the care of the religious concerns of the people, in connection with which he had to act as prosecutor of murderers and offenders against religion. The third archon had the name of Polemarch, and was originally entrusted with the superintendence of military matters, though in later times his duties were chiefly confined to the protection and superintendence of the resident

aliens. The rest of the archons were called Thesmothetæ, and exercised a general supervision over the laws of the state.

Archytas, är-kī'tās, an ancient Greek, a native of Tarentum, a famous Pythagorean philosopher, renowned also as a truly wise man, a great mathematician, statesman, and general. He was the contemporary of Plato and flourished about 400–365 B.C., but the dates of his birth and death are unknown. The invention of the analytic method in mathematics is ascribed to him, as well as the solution of many geometrical and mechanical problems. He constructed various machines and automata, among the most celebrated of which was his flying pigeon. Plato is said to have borrowed some of his opinions from Archytas, and Aristotle also is said to have been indebted to him for the idea of his categories and some of his ethical opinions. These opinions, however, appear to depend on spurious writings, the real remains of Archytas being of inconsiderable value. Horace mentions him in one of his poems (Carm. i. 28) as having been drowned on the coast of Apulia.

Arcif'era (Latin, *arcus*, bow, + *ferre*, to bear, carry), a division of Anura, including the toads.

Arcis-Sur-Aube, är'se'sü'rōb', France, a town of the department of Aube on the river Aube. It is the birthplace of Danton, to whom a monument was erected here in 1886. In 1814 a battle was fought here between Napoleon and the allies in which the latter, with a much superior force, had the advantage and afterward marched to Paris. Pop. 2,841.

Ar'co, Austria, a town in the Tirol, not far from the Lake of Garda, on account of its situation and mild climate a favorite winter resort of invalids. Pop. 3,782.

Arcole, är'kō-lā, a village in North Italy, in the province and 15 miles southeast of the town of Verona, on the left bank of the Alpone, celebrated for the battles of 15, 16, and 17 Nov. 1796, fought between the French under Bonaparte and the Austrians in which the latter were defeated with great slaughter.

Arçon, är-sôṅ, **Jean Claude Eléonore d',** a French military engineer: b. Pontarlier, 1733; d. 1 July 1800. He was received into the military school at Mézières, 1754, and in the Seven Years' war he highly distinguished himself, particularly at the defense of Cassel in 1761. In 1780 he invented the floating batteries for the attack of Gibraltar, which, however, were destroyed by the red-hot shot of the besieged. At the invasion of Holland under Dumouriez (in 1793) he took several places, including Breda. He then went into retirement, where he wrote his important ‹Considérations Militaires et Politiques sur les Fortifications› (1795).

Arcona. See ARKONA.

Arcos de la Frontera, är'kōs dā la frōntā'rā, a town in Spain in the province of Cadiz, on the right bank of the Guadalete, which is here crossed by a stone bridge. The sandstone rock on which the town, in form of a bow, is placed, rises 570 feet above the level of the river, which surrounds it on three sides. The houses are mean looking; the streets paved, but generally steep and narrow; and the ancient walls and defenses are in a ruinous state. On the highest part of the rock stands the castle of the dukes of Arcos, partly in ruins. Pop. (1900) 15,700.

Ar'cot, är-kŏt', the name of two districts and a town of India within the presidency of Madras. North Arcot is an inland district with an area of 7,256 square miles. The country is partly flat and partly mountainous. Pop. 1,817,-814. South Arcot lies on the Bay of Bengal, and has two seaports, Cuddalor and Porto Novo. Pop. 1,814,738. The town of Arcot is in North Arcot, on the Palar, about 70 miles west-by-south of Madras. There is a military cantonment 3 miles distant. The town contains handsome mosques, a Nawab's palace in ruins, and the remains of an extensive fort. Arcot played an important part in the wars which resulted in the ascendency of the British in India. It was taken by Clive, 31 Aug. 1751, and heroically defended by him against an overwhelming force under Rajah Sahib. Pop. 11,000.

Arc'tic, a term applied to the North Pole, or the pole raised above our horizon, from the proximity of the constellation of the Bear, in Greek called *arktos*. The Arctic circle is an imaginary circle on the globe, parallel to the equator, and 23° 28' distant from the North Pole, from whence its name. This and its opposite, the Antarctic, are called the polar circles. Within these circles the sun does not set during a part of the year, and during a corresponding part does not rise.

Arc'tic Charr. See TROUT.

Arc'tic Re'gion, the name given to the region of land and water surrounding the North Pole, reaching on all sides to lat. 66° 32' N. The Arctic or North Polar circle touches the northern headlands of Iceland; cuts off the southern and narrowest portion of Greenland; crosses Fox Strait north of Hudson Bay, whence it goes over the American continent to Bering Strait. Thence it runs to Obdorsk at the mouth of the Obi; then, crossing northern Russia, the White Sea, and the Scandinavian peninsula, returns to Iceland.

Climate.— The most important facts now ascertained respecting the climate of the Arctic regions are, that the main line of extreme cold extends across the Polar Sea from the meridian of 90° W. to that of 130° E., reaching much farther on the Asiatic than on the American side, so that the winter temperature of Yakutsk (lat. 62° 2') is 7° F. lower than that of Rensselaer harbor, in Smith Sound (lat. 78° 37'). But the American limit of cold oscillates much less than the Asiatic, the summer temperature at Rensselaer harbor being but 62°, while at Yakutsk it is 95° F. above that of winter. This difference is due to the absorption of summer heat by the comparatively dry plains of Siberia, while on the North American continent the numerous lakes and inlets moderate the climate throughout the year. To this it may perhaps be added that Greenland, owing to its peculiar constitution and position, is to North America a source of refrigeration which has no counterpart in the eastern continent. This circumstance, and the humid atmosphere maintained by the numerous lakes, somewhat moderates the severity of the cold, but at the same time renders it somewhat more constant.

Arctic Ocean.—In its widest sense that portion of the ocean which extends from the Arc-

NORTH POLAR REGIONS
SCALE OF MILES
PACIFIC OCEAN
BERING SEA
SEA OF OKHOTSK
JAPAN SEA
CHINA
MONGOLIA
SIBERIA
ALASKA
DOMINION OF CANADA
HUDSON BAY
BAFFIN BAY
DAVIS STRAIT
GREENLAND
GREENLAND SEA
DENMARK STRAIT
ICELAND
ARCTIC CIRCLE
ARCTIC
UNKNOWN
NORTH POLE
FRANZ JOSEF LAND
SPITZBERGEN
NOVAIA ZEMLIA
BARENTS SEA
Kara Sea
LIAKOV IS. OR NEW SIBERIA
NORTH SEA
BALTIC SEA
BRITISH ISLES
FRANCE
ATLANTIC OCEAN
MEDITERRANEAN SEA
NEWFOUNDLAND
Longitude West from Greenwich

tic Circle (lat. 66° 32′ N.) to the North Pole, or more restrictedly from about lat. 70° N. Assuming the former limit, the Arctic Ocean is found entering deeply, in the form of gulfs, bays, etc., into the northern parts of the continents of Europe, Asia, and America. The principal of these indentations are the White Sea in Europe; Kara Sea, Gulfs of Obi and Yenisei in Siberia; and Baffin Bay in North America. It is united to the Pacific by Bering Strait, and to the Atlantic by a wide stretch of sea extending from Greenland to Norway. Among the principal islands of the Arctic Ocean are Greenland (at last proved to be an island) and east of Greenland the extensive group known under the name of Spitzbergen, the small island of Jan Mayen, and Iceland. West of Greenland and divide from it by Davis Strait and Baffin Bay there are a considerable number of islands of great size but little interest. North of Europe are the islands of Nova Zembla; and north from these Franz Josef Land, an archipelago as yet imperfectly known. The water of the Arctic Ocean is extremely pure, shells being distinctly visible at a great depth; it also presents rapid transitions of color, chiefly from ultramarine to olive-green, the latter variations of color being produced by myriads of minute animals belonging for the most part to the *Cœlenterata* and *Mollusca* classes. Many have adopted the belief in the existence of an open polar sea about the North Pole. But this belief is not supported by any positive evidence. Ice is nearly constant everywhere between Spitzbergen and the southern point of Greenland. This is called the main north ice. East of Spitzbergen and near Nova Zembla the sea is always beset, if not completely barred, by ice. In Baffin Bay and thence west to Bering Strait numerous expeditions have had a perpetual struggle with ice. The expedition of 1875–6 under Captain Nares, members of which reached a point 30 miles further north than had ever previously been attained, proceeding by way of Baffin Bay and Smith Sound, found no indications of an open polar sea. On the contrary the explorers found north of 82° 27′ a sea consisting of one unbroken sheet of old ice of immense thickness, which effectually barred the further progress of the vessels, while the ruggedness of the ice rendered it impossible to reach the pole by sledge. Nansen more recently found abundance of ice in the tract of sea crossed by him.

Arctic Current.— It seems certain that a current sets into the polar basin along the coasts of Norway and Lapland. It is probably the effect of prevalent southwest winds, though some call it a branch of the Gulf Stream. There is also a strong current running in at Bering Strait. On the other hand, along the east coast of Greenland and in Baffin's Bay the movement is generally south. In the numerous channels between Baffin Bay and Bering Strait the tides are regular but feeble; indeed, it seems possible to trace across Barrow Strait the line of neutralized or no tide, and this, there is reason to suspect, is also the line of comparatively permanent ice.

Minerals.— Valuable minerals, fossils, etc., have been discovered within these Arctic regions. In the archipelago north of the American continent excellent coal frequently occurs. The mineral cryolite is mined in Greenland and carried to the United States. Among other fossils the remains of large saurians are found in the Lias, which extends widely over the northern archipelago, and ammonites collected in abundance prove that in lat. 73° north there was once a tropical temperature. The group of islands opposite the mouth of the Lena, in lat. 73°, are little more than accumulations of fossil remains carried down by the river, and are annually visited for the purpose of digging fossil ivory.

Vegetation.— The plants peculiar to the frigid zone are stunted more by the dry winter winds than by short growing seasons and long winters. The reduction is confined to the limbs, as roots are as long and penetrate as far as in more temperate climates. The vegetation is widely distributed, the species found in North America being practically the same as those found in Europe and Asia, and since trees become more and more scarce as the Pole is approached, the prevalence of the tundra formation is characteristic of the region. In respect to distribution, arctic plants differ from alpine plants (q.v.) which though otherwise similar, especially in the census of cushion and rosette plants and plants with thick-skinned evergreen leaves, include many endemic species. Arctic perennials are noted for the high percentage of species that develop wintering flowering buds which burst into bloom early in the spring. In the Arctic zone, less than two thousand species have been described, among them very few trees. These are mostly stunted willows, junipers, and birches, and beyond their northern limits flowering plants, grasses, mosses, and lichens extend as far as man has penetrated. Commonest among the flowering species are crowfoots, potentillas, poppies, saxifrages, whitlow grass (*Draba*) and scurvy grass (*Cochlearia*). Thyme and angelica, growing in sheltered spots, are the only perfume-bearers.

The English expedition of 1875-76 found 20 or 30 species of phanerogamous plants between lat. 82° and 83°. From Churchill River on the west side of Hudson Bay (lat. 53°), the line limiting the forest runs constantly to the north of west till it reaches Norton Sound, a little south of Bering Strait, larch and poplar making their appearance as we go west. In Siberia, where the summer heat is greater, woods flourish to a much higher latitude within the Polar Circle. In the Scandinavian peninsula the red pine reaches lat. 69°, the Scotch fir 70°, the birch 71°. Animal life is by no means deficient within the Polar Circle. Species indeed are few, but the individuals are extremely numerous. The proof of this is to be found in the immense number of skins of fur-bearing animals, eider ducks, seals, walrus, etc., annually supplied to commerce. Recent expeditions have found the usual arctic quadrupeds and birds as far north as the land extended. How far north the cetaceans reach is doubtful. See Distribution of Animals.

Notwithstanding this apparent abundance, the human being has in general a severe struggle for subsistence beyond 64° N. lat., although traces of Eskimos have been found as far north as 81° 52′. The Eskimos who inhabit Greenland and the extreme north of America have a hard life of it, often pressed, and not seldom cut off, by famine. Under their rigorous skies the resources derivable from the surrounding abundance of animal life can support

only a handful of men. Even in Siberia, where the reindeer trained to the sledge, and the great rivers frozen throughout the winter, add so greatly to the facilities of intercourse or emigration, whole communities are frequently cut off by famine or disease. Yet we see Europeans settled under the parallel of 73° at Upernavik in Greenland, of 72° 2′ at Ustyarsk in Siberia, and of 70° 40′ at Hammerfest in Norway, and Europeans have wintered far north of this. The settlements in Greenland, northern Siberia, Kamchatka, and the Hudson Bay territories are all more or less connected by trade with southern countries, whence they derive their power of endurance; and from the constant care required in order to guard against the consequences of the severe climate it is evident that to man the support of life within the Polar Circle must ever be difficult and precarious. Nevertheless, owing to the abundance of lower animal life, men have visited these regions for centuries to gather the exceedingly rich harvests of furs and oil.

Arctic Exploration.— See POLAR RESEARCH. The following are the farthest points of north latitude reached by Arctic explorers up to the present date: 1607, Hudson, 80° 23′; 1773, Phipps, 80° 48′; 1806, Scoresby, 81° 12′ 42″; 1827, Parry, 82° 50′; 1874, Meyer (on land), 82°; 1875, Markham and Parr (Nares' expedition), 83° 20′ 26″; 1876, Payer, 83° 07′; 1884, Lockwood (Greely's party), 83° 24′; 1896, Nansen, 86° 14′; 1900, Abruzzi, 86° 33′.

Bibliography.— Conway, 'The First Crossing of Spitzbergen'; Greely, 'Arctic Service'; 'Handbook of Arctic Discovery'; and 'Report on the Proceedings of the United States Expedition to Lady Franklin Bay'; Hayes, 'Arctic Boat Journey'; Jackson, 'A Thousand Days in the Arctic'; and 'The Great Frozen Land'; Jones, T., 'Natural History, Geology, and Physics of Greenland and Adjacent Regions'; Kane, 'Arctic Explorations, the Second Expedition in Search of Sir John Franklin'; Nansen, 'Farthest North'; Peary, 'Northward Over the Great Ice'; Ray, 'Report of the Expedition to Point Barrow'; Wright, 'Greenland Ice Fields and Life in the North Atlantic.'

Arctu'rus, a fixed star of the first magnitude in the constellation of Boötes, and thought by some to be one of the largest of the fixed stars. It has a large proper motion, and is a noticeable object in the northern heavens.

Ar'cus Seni'lis, a term applied to a white or grayish white rim on the outer edge of the cornea, due to the infiltration of a finely granular hyaline substance, heretofore thought to be a form of fatty degeneration. This is probably not the case, since the infiltration material has no relation to the corneal cells. It is more probably a condition due to changes in the blood vessels of the cornea and is frequently a result of old age. It is a normal phenomenon, however, occurring sometimes in perfectly healthy people, and there is no invariable relationship to fatty degeneration of the blood vessels, heart, or other organ.

Ardagh, är'dä, **Sir John Charles,** an English military officer: b. 1840. He entered the Royal Engineer Corps in 1859; and became major-general in 1898. He attended the Conference of Constantinople, Congress of Berlin, Bulgarian Boundary Commission, and the Peace Conference at The Hague, in 1899, and was for many years director of military intelligence in the British war office.

Ardahan, är'da-hän', a village in the portion of Turkish Armenia ceded in 1878 to Russia, 35 miles northwest of Kars. Its position gives it strategic importance. Its fortress was dismantled by the Russians in the war of 1854-6; in 1878 the Berlin Congress sanctioned the cession to Russia of Ardahan, which had been captured early in the war.

Arditi, är-dē'te, **Luigi,** an Italian musician and composer: b. Piedmont, 16 July 1822; d. Hove, Sussex, 1 May 1903. Famous first as a violinist, then as a conductor, he went to London in 1857, and from that year till 1878 was musical director at Her Majesty's Theatre. He has conducted Italian opera and concerts in places as remote from one another as New York and Constantinople; has published the operas 'I Briganti' (1841); and 'La Spia' (1856); and is known as author of much popular music — songs, violin duets and waltzes, such as 'Il Bacio.' He published his 'Reminiscences' in 1896.

Ard'more, Indian Territory, a city of the Chickasaws, on the Gulf, Colo. & Santa Fe, and Choctaw, Okla. & Gulf R.R.'s, about 20 miles north of the Red River. It is the seat of Hargrove College. Its commercial interests are cotton, coal, and asphalt. Pop. (1900) 5,681.

Are'ca, the designation of a genus of palms, possessing pinnate leaves, a double membranous sheath containing its bunches of flowers; fruit a one-seeded berry or drupe, with a fibrous rind. To this genus belongs the betel-nut or pinang palm (*A. cathecu*), a native of the East Indies, and cultivated there in many varieties. It is a very beautiful palm, with a slender stem often 40 or 50 feet high. Its nuts, called betel-nuts, are rolled into a leaf of the betel-pepper along with a little lime, and are then chewed. The nut contains at least four alkaloids, Arecoline, Arecaïdine, Arecaïne, and Guvacine, the former alone having known active properties. Arecoline is an active taeniacide and is widely used in veterinary practice for the treatment of tape worms. It is also an active cathartic and mydriatic. In the latter case it is extensively used as a stimulant. Another palm of this genus is the cabbage palm (*A. oleracea*), one of the most beautiful and stately of the palm tribe, with a stem rising often to the height of 200 feet, terminated by a graceful plume of waving feathery foliage. It is a native of Jamaica and other West India Islands. The so-called cabbage is the terminal leaf-bud, which is very tender and delicious, either raw or boiled. Its removal, however, kills the tree.

Arecibo, ä'rā-sē'bō, an important commercial town of Porto Rico; on the northern coast; facing the Atlantic Ocean; 50 miles west of San Juan. It resembles ordinary Spanish towns in having a plaza, surrounded by the church and other public buildings, in the centre, with streets running from it in right angles, forming regular squares. The buildings are of wood and brick. The harbor is poor, being exposed to the full force of the ocean, and having no nat-

ural or artificial protection. Imports and exports can be handled only by twice lightering. Tributary to the town is a district of about 30,000 inhabitants. Pop. (1903) about 12,000.

Ar'ena'ceous Rocks, the name applied to a petrographic division including loose sands and gravels, sandstone, conglomerate, quartzites and such rocks as are mainly composed of quartz particles. They are of mechanical origin, being derived from disintegration of pre-existing strata and removal and deposition of the materials by wind or water. The grains are generally waterworn and rounded; in some cases, however, they are more or less angular, or rounded and angular grains occur commingled. In older deposits, the grains of sand are bound together by silicious, calcareous, argillaceous, or ferruginous cements. It is seldom that a rock is composed of quartzose materials alone; grains or particles of other mineral substances are frequently mingled with the grains of quartz. Silvery flakes of mica are seldom absent; often occurring in layers parallel to the planes of stratification, thus causing the rock to split into thin slabs, and exposing a glittering surface. These are called micaceous sandstones. When grains of feldspar occur, the rock is a feldspathic sandstone. Often large quantities of calcareous matter, either as cement or as distinct grains occur; and these are called calcareous sandstones. In like manner we have silicious and ferruginous sandstones, when silica and oxid of iron are conspicuously present as cementing or binding materials. Clay and carbonaceous matter, when plentifully diffused through the rock, give rise to argillaceous, carbonaceous and bituminous sandstones. Greensand, or glauconitic sandstone, is a rock containing abundant grains of the dirty greenish mineral called glauconite. Arkose is a sandstone composed of disintegrated granite; volcanic sandstone, trappean sandstone, etc., being composed of disintegrated igneous rocks. The presence of lime can always be detected by the effervescence which takes place on the application of hydrochloric or other acid. A sandstone of homogeneous composition, which may be worked freely in any direction, is called freestone or liver rock. Flagstone is a sandstone capable of being split into thin beds or flags along the planes of deposition. When the sandstone is coarse-grained, it is usually called grit. If it contain, more or less abundantly, grains large enough to be called pebbles, the sandstone is said to be conglomeratic; and if the pebbles or stones be angular, the rock is described as a brecciiform sandstone. Coarse-grained grits and pebbly or conglomeratic sandstones pass into conglomerate or puddingstone, which consists of a mass of various sized water-worn stones. Brecciiform sandstones frequently pass into breccia, an aggregate of angular and sub-angular fragments. Graywacke is an argillaceous sandstone, more or less altered and sometimes semicrystalline, met with among palæozoic formations.

Arenales, ä'rā-nä'lĕs, **Juan Antonio Alvarez de**, a Peruvian patriot: b. 1775; d. 1825. When the Spanish army invaded Peru, Arenales led a body of troops against them by a long circuitous route, and defeated Marshal O'Reilly, whom he made prisoner, 6 Dec. 1820.

Ar'ena'ria, the name given to a genus of plants of the sandworts, of the *Caryophyllacaæ* or pink family. They number upward of 200 species, and are usually low-tufted herbs with white flowers. They are very common along the American sea-coast and in sandy places throughout the States north of the Ohio River. Several species are alpine or sub-alpine in habit and are found on the summits of the Eastern Appalachian. Of these the mountain sandwort (*A. Groenlandria*) is best known.

Areng' Palm, the name of a palm, formerly called *Areng saccharifera*, but now more generally denominated *Saguerus saccharifer*. It belongs to the section *Cocoinæ*, grows wild in the islands of southern Asia, and is cultivated in India. It furnishes sago and wine, while its fibres are manufactured into ropes.

Ar'eop'agus, the designation of the oldest Athenian court of justice. It obtained its name from its place of meeting, on the Hill of Ares (Mars), near the citadel. Its establishment is ascribed by some to Cecrops, by others to Solon; from the latter, however, it seems to have only received a better constitution and more important privileges, and it is probable that it existed from very remote times. Of how many members it consisted is not now known. A seat in it was held for life. The members were men who in their former capacity of archons had rendered themselves worthy of this honor by the honest and diligent execution of their office, and whose character and conduct had been subjected to a particular examination. Aristides called the Areopagus the most sacred tribunal of Greece, and Demosthenes assures us that they never passed a sentence in which both parties did not concur. Crimes tried before this tribunal were wilful murder, poisoning, robbery, arson, dissoluteness of morals, and innovations in the state and in religion; at the same time it took care of helpless orphans. The other states of Greece sometimes submitted their disputes to the judgment of the Areopagus. Its meetings were held in the open air and in the night time. After the investigation of a case the votes were collected. In the time of Pericles its political influence was materially lessened, but it continued a much venerated assemblage, and in Roman times its decisions still commanded respect. The Apostle Paul is sometimes thought to have been brought before this ancient court, but it is more likely that his famous address on Mars Hill was before an asemblage of philosophers there. See Botsford, 'The Athenian Constitution' (1893).

Arequipa, ä'rā-kē'pa, a city of Peru, the capital of a department of the same name. It lies in a fertile valley 200 miles south of Cuzco, at the height of 7,850 feet above the sea. Prior to the earthquake of 13 Aug. 1868, which did not leave a single house habitable, it was one of the best-built towns of South America. Behind it rise three lofty mountains, one of which, called the volcano of Arequipa, or Peak of El Mistè, is one of the most elevated summits of the Andes, having a height which Pentland estimates at 20,328 feet. It contains a cathedral, a college, a hospital, nunneries, convents, etc. Near at hand Harvard University has an observatory, at an altitude of over 8,000 feet. It is subject to frequent earthquakes, but this evil seems to be overbalanced by the mildness of the climate, and the beauty and fertility of

the country round about. Islav was formerly the port of Arequipa, but it has been superseded by the neighboring port of Mollendo, connected by railway with Arequipa. Pop. (1901) 35,000.

Argall, Sir **Samuel**, seaman and American colonial official: b. Walthamstow, Essex, England; d. 24 Jan. 1626. He was a type of the founders of English colonial dominion — energetic, resourceful and masterful; his further repute as a sort of unprincipled buccaneer and tyrant is due to sentiment and partisanship. In May 1609, he was sent with a small barque to the new settlement at Jamestown, Va., to trade and fish on behoof of the owner. He seems to have found a shorter route than usual, and soon established a reputation for unprecedentedly quick passages. The next year he took out Lord Delawarr to Jamestown, arriving just in time to prevent the entire colony, with the governor, Sir Thomas Dale, leaving for Newfoundland to avoid starvation. He was sent to the Bermudas for swine to replace those the colonists had eaten up, but was driven by storms to Cape Cod, where he found good fishing and returned in August; established a corn trade with the Indians above Jamestown, and early in 1611 returned to England with Delawarr, whose health was bad. In September 1621, he was again at Jamestown after the then swift passage of 51 days, and the rest of the year he and Dale spent in corn-hunting among the Indians. Powhatan had a number of English prisoners in his hands, and a quantity of weapons and implements; and Argall, hearing that the chieftain's daughter Pocahontas was with her uncle "Powtownec" (Potomac), had the happy thought of securing her to exchange against them, a feat accomplished by threats and the offer of a copper kettle to her uncle. The stock denunciation of him for this "nefarious treachery" is best answered by the fact that no one was harmed, all parties were benefited, and a most desirable aim was achieved. Pocahontas herself considered it a piece of rare good fortune, would not leave the whites, and soon after married one of them, while the prisoners were released, and peace restored to the colony. Argall handed her over to Sir Thomas Gates and explored the east shore of Chesapeake Bay, fishing and trading. Later in the year he was sent with a vessel of 14 guns to destroy the French settlements on the north coast, regarded as infringing on the Virginia patent. He captured Mount Desert, St. Croix, and Port Royal (N. S.), carried off the settlers as prisoners to Jamestown, and on the way forced the commandant at New Amsterdam to recognize English suzerainty by hauling down the Dutch flag and running up the English. In 1614 he sailed for England, and was put on his defense for these high-handed acts, but completely justified himself. In May 1617, he was made deputy-governor of Virginia, and remained two years in a broil with part of the citizens, but justified by others. He was accused of illegal trade with the West Indies, and repeatedly ordered to return to England for trial, a command which he ignored for a time, possibly in reliance on the Earl of Warwick, who financed and shared his ventures. In 1620 he served against the Algerine pirates with a 24-gun merchant vessel, under Sir Robert Mansell. He was knighted in 1622. In 1625 he was admiral of a squadron cruising after a hostile Dunkirk fleet, and took some prizes. On 3 October of that year he embarked with the squadron in the expedition against Cadiz under Lord Wimbledon, with Lord Essex on board as vice-admiral and commander of land forces; Argall's flagship was the Swiftsure. He reported the fortress too strong to be taken without a siege, the merchant vessels were ill supplied and unpaid, and after waiting till December for relief from Charles I. they went home. Argall died the next month, it was said from a broken heart because the captain of the Swiftsure was "very backward and cross" to him. (Argall's own narrative comes down to 12 May 1613.)

Argenteuil, är-zhän-tė-y, a town in France, on the right bank of the Seine, seven miles below Paris. It supplies much wine, fruit, and vegetables for the Parisian market. The famous Héloïse was abbess of its now ruined priory from 1120. Pop. (1896) 15,126.

Argentina, är'jĕn-tē'na, or the Argentine Republic, the second in size of the South American countries, extends from Bolivia, in the torrid zone, to Cape Horn, in the frigid zone. A just idea of its great length and climatic range may be given by comparison with the United States. The distance from its northern boundary to the equator is much less than from the equator to Florida; the territory of Tierra del Fuego is as near to the South Pole as Prince of Wales Island, Alaska, is to the North Pole. In its tropical north are valuable mines and forests of hardwoods; in the extreme south the collecting and storing of natural ice is a profitable industry. All the central provinces and territories have the climate of the temperate zone, and lie in one vast plain stretching from the Andes to the Atlantic. Above Buenos Ayres, however, the eastern limit of Argentina is not the ocean, but a river system exceeding in volume that of the Mississippi,— the Paraná and Uruguay rivers furnishing an outlet for the products of the region bordering on Uruguay, Brazil, and Paraguay, and finally uniting in the great Rio de la Plata.

History.— A Spanish captain named Juan de Solis discovered the Rio de la Plata several years before Magellan saw it (1520), and, according to the account of Pigafetta, one of Magellan's companions, the "gigantic natives called canibali ate De Solis and 60 men who had gone to discover land, and trusted too much to them." Again, in 1535, the Indians destroyed a colony that Pedro de Mendoza attempted to establish on the site of the modern city of Buenos Ayres, no permanent settlement being made at that place before 1580. In 1661 the king of Spain created a high court in Buenos Ayres, and appointed a governor and captain-general for the provinces of the Rio de la Plata. The provinces increased in importance to such an extent during the century which followed that in 1773 the King's representative became a viceroy. British forces, sent to capture Buenos Ayres in 1806 and 1808, were defeated by the natives, unaided by the viceroy; the resignation of the latter was demanded on 25 May 1810, and the patriotic movement did not cease until independence was achieved. A junta composed of nine members, assuming the reins of government, despatched revolutionary expeditions into Paraguay, the northern provinces of Argentina and Alto Peru (now Bolivia); for it was evident not only that the power of Spain


ARGENTINE REPUBLIC, PARAGUAY, URUGUAY AND CHILE.
SCALE OF MILES.
Population of places is indicated by different lettering, thus;
200,000 and over......BUENOS AIRES
100,000, to 200,000..........Valparaiso
50,000, to 100,000..........Rosario
10,000 to 50,000..........La Plata
Smaller Towns..........Posorro
Railroads
BUENOS AIRES
RIO DE LA PLATA
BOLIVIA
BRAZIL
PARAGUAY
URUGUAY
ARGENTINE REPUBLIC
PACIFIC OCEAN
ATLANTIC OCEAN
MONTEVIDEO
BUENOS AYRES
Valparaiso
SANTIAGO
Juan Fernandez Is.
CORDOBA
MENDOZA
SAN JUAN
TERRITORY OF THE CHACO
TERRITORY OF MISIONES
CORRIENTES
ENTRE RIOS
TERRITORY OF THE PAMPAS
TERRITORY OF THE RIO NEGRO
TERRITORY OF THE CHUBUT
TERRITORY OF SANTA CRUZ
SANTA CATHARINA
RIO GRANDE DO SUL
Golfo de San Matias
Golfo de San Jorge
Golfo de Penas
Chonos Archipelago
Bahia Grande
Strait of Magellan
Falkland Islands (British)
Stanley Harbour
Rio de la Plata
Copyright 1903, by The Americana Company
West from Greenwich

could not be broken without the united efforts of the patriots who were scattered throughout the southern portion of the continent, but also that Argentina was the natural leader in such enterprises.

During seven years the issue remained in doubt: all the advantages that the Argentine general, Belgrano, gained at first seemed to be lost when he suffered defeat at the hands of Gen. Peguela in Dec. 1813. But six months afterward the nearest and most threatening Spanish stronghold, the fortress of Montevideo, was captured. Independence was declared, 9 July 1816, at a congress representing the different provinces; then Gen. San Martin led across the Andes a force of 5,000 Argentina soldiers recruited largely from the hardy plainsmen and cowboys (*gauchos*). His little army of "rough riders," by defeating the Spanish troops in the battle of Chacabuco, gave independence to the Chilean people. San Martin was also successful against the Spaniards in Peru, entering Lima as a liberator in 1821. Though urged to accept the civil government of the countries he had freed, this soldier of splendid ability refused the rewards, honors, or offices in civil life, which those men fulfilling similar missions in other lands have almost without exception consented to receive. Moreover, the attitude of the Argentine revolutionists in general was characterized by disinterestedness in this crisis; and subsequently, when Brazil sought to annex Uruguay, Argentina appeared as the champion of the smaller state. A war lasting three years (1825–8) was required to convince Brazil that Uruguay's independence must be guaranteed by both her great neighbors. But the bright prospects of Argentina herself suffered eclipse from 1829 to 1852. Juan Manuel de Rosas succeeded in establishing a virtual dictatorship, maintaining himself in power despite repeated attempts to oust him, until the year last mentioned, when he was defeated by Gen. Urquiza in the battle of Caseros. Taught by experience, the people now resolved to safeguard their rights and privileges for the future. A constitution closely resembling that of the United States (though president and vice-president hold office for six years, and senators for nine, and other interesting adaptations were made) was promulgated 25 May 1853. In 1862–8 we see Argentina, allied with Brazil and Uruguay, engaged in resisting Paraguay's claim to ownership of the territory El Chaco. The allies were successful in the field; nevertheless the dispute was referred to the President of the United States, Mr. Hayes, as arbitrator. Such respect for law, as superior to force of arms, was shown during Gen. Bartolomé Mitre's term of office. Significant administrations were those of Señor Sarmiento, who succeeded Gen. Mitre, of Señor Avellaneda, and of Gen. Roca. The first of these was familiar with the United States, where he had resided as Argentina's diplomatic representative, and the efforts he made to bring the institutions of his own country into harmony with those he had studied at Washington — especially in the matter of popular education — helped progressive Argentina to earn the title of the "Yankee-land of South America." General Roca, as minister of war during Avellaneda's presidency, extended the southern frontier so that it included a large part of Patagonia; his first term of office as President is memorable on account of the extension of the railway system, the erection of many public school buildings, the formal selection of the city of Buenos Ayres as the capital of the republic, and the foundation of the city of La Plata (1882). A financial crisis that afflicted the country caused the resignation of President Celman, who succeeded Gen. Roca in 1886. The people, convinced that the President's policy was responsible for the "hard times," practically forced him out of office by the pressure of public opinion. This may be regarded as a striking demonstration of the power of unfeigned and non-partisan disapproval, inasmuch as a revolutionary movement was first attempted and proved a failure. Vice-President Pelligrini brought so much skill to the tasks thus devolving upon him as Celman's successor, that he guided the country safely out of its troubles. The question of limits with Bolivia, Chile, and Brazil continuing to occupy the attention of the Argentine foreign office during the presidency of Peña (succeeding Pelligrini, 12 Oct. 1892), the preference for deciding boundary disputes by arbitration without a preliminary war, was strongly manifested, as was but natural after the El Chaco affair. President Roca (re-elected) was able to report the satisfactory financial conditions in 1902, to which reference will presently be made; also the decision of the question of the boundary between the Argentine Republic and Chile by the award of the arbitrator, King Edward VII., dated at the court of St. James, 20 Nov. 1902.

Immigration and Population.— The Constitution of Argentina provided that "The federal government shall encourage European immigration, and shall not restrict . . . the entry . . . of foreigners who come for the purpose of engaging in the cultivation of the soil," etc. The greater part of the land of the republic being devoted to grazing and the production of live stock, while its value for agricultural purposes is still greater, immigrants have been attracted by a liberal policy which both the federal and provincial governments adopted: the former, in addition to free grants of land, has advanced capital (oxen, tools, etc., to the value of $1,000 for each farmer) to be paid back in five years. There were 125,951 immigrants in 1901, the nationalities represented being as follows: Italians, 58,314; French, 21,788; Spaniards, 18,066; Austrians, 2,714; Syrians, 2,159; Russians (chiefly Poles), 2,086. The area of lands under cultivation shows such an increase as might be expected — 17,174,250 acres in 1902, as against only 7,478,700 acres in 1880. The total population of the Republic 1 Jan. 1902, was 4,749,149.

The city of Buenos Ayres, with 821,291 inhabitants, ranks as the eleventh city of the world in respect to population.

Education.— For both boys and girls between the ages of 6 and 14 years education is compulsory and gratuitous. There is one school for each 1,000 inhabitants. Córdoba and Buenos Ayres have universities. Military and naval academies, a national observatory, trade schools, and an academy of mining engineers, have already been established, and it is the government's purpose to add to these practical

schools for the instruction of laborers in rural industries and forestry near the capital or principal city of each province. Primary education is under the direction of a national board of education, which has practically full control of the public schools and enjoys an income of its own. The matriculates in different grades in 1901 numbered 69,958 in the city of Buenos Ayres alone. There are more than 200 public libraries in the country, the government adding an equal sum to any endowment by private gift.

Public Spirit.— Enthusiasm for the public good and national advancement is an Argentine characteristic. One of the 20 daily newspapers published in Buenos Ayres devotes a large part of its costly building to public uses for the glory of the city. At its own expense it provides a free consulting room, where a physician and five assistants minister to the sick; a law office where indigent persons secure free legal advice; a museum of the products and manufactures of the republic; a library open to students without payment; a great hall for public meetings; a charming *salon des fêtes*, where literary, charitable, and scientific meetings are held: even a palatial suite of apartments for the reception of distinguished foreigners. The trait illustrated by this liberal undertaking differentiates the people of Argentina somewhat from other nations of the continent: yet they have their full share in the common Latin-American love of amusements.

Railways.— The enormous extent of flat country (Argentina's total area being 1,118,000 square miles), favors the construction of railways. More than 20 lines, having an extension of about 9,000 miles in the aggregate, are in actual working order, while a score of new lines are being built. The capital invested amounts to about $553,000,000 gold. Of the 20 lines completed before 1900, 16 were English and 4 belonged to the Argentine government. The accommodations for passengers are excellent. In December 1901, the Argentine Congress granted a concession for an important railway which is to cross the Territory of Misiones, form the connecting link between the Brazilian and Argentine systems, and constitute a section of the grand chain of railroads which will eventually traverse North and South America. The Buenos Ayres and Valparaiso Transandine Railway is the end of a long series of lines destined to be a fraternal as well as a commercial tie between the Chilean and Argentine republics. The telegraph lines of the republic have a length of 15,074 kilometres and represent an invested capital of about $5,000,000.

Sanitation.— The water-works and sewerage systems of the city of Buenos Ayres engaged the best engineering skill available. The cost of the latter even before 1890 was $34,000,000 gold. The city's death rate is 17 for every 1,000 inhabitants, as against 18.4 for the city of New York. Public hygiene is the object of government aid in the Argentine ports.

Capital City.— Whereas long ago the merchants of Seville sent every commodity to Buenos Ayres, the Argentine capital now takes little or nothing from Spain. It has lost its Spanish aspect, a preference being shown for the French style in architecture and the interior furnishings of the houses. The bustling activity in its business streets, the vitality, enterprise, and ambition of its inhabitants, are characteristically American. The foreign population numbers over 200,000, and the influence of German and English customs has also been felt. In fine, it is a cosmopolitan town; its people are not only devoted to the theatre and the race track, but are intelligent and much interested in the education of their children. Modern docks extending three miles along the city's front have been constructed at a cost of $25,000,000. Among the noteworthy buildings are the hall of justice, artillery arsenal, mint, stock exchange, Colon theatre, museum of natural history, and cathedral (begun in 1580; rebuilt in 1752). An English syndicate has acquired the concession of an underground electric road, to connect Victoria Place, at the centre of the city, with the Western Railroad station — a distance of about two and a half miles. Palermo Park, always beautiful, is especially so at night when illuminated by its arches of electric lights. The city and suburban street railway system has about 600 miles of track. It has been developed chiefly by English capital.

Provinces.— La Plata, a spacious, handsome city of 50,000 inhabitants, is the capital of the province of Buenos Ayres. The area of this province is greater than that of the State of New York; its population 1 Jan. 1902 was 1,140,067; its soil is a rich alluvium above clay — the latter being used largely in the manufacture of pottery. Almost the entire province is laid out in cattle farms, and immense quantities of salted beef, hides, and tallow are exported. It has been estimated that there are 200 sheep, 20 cows, and 6 horses to every inhabitant. The province of Entre Rios (population, 343,684) produces the best wheat. Córdoba province (population, 419,072) produces copper, silver, gold, marble, lime, etc., as well as cattle, horses, and sheep. In general we may say that the chief mining regions are near the northern and western boundaries of the republic. Thus, Jujuy, the most northwesterly province, has mines of gold, silver, copper, mercury, salt, and asphalt. Its capital, the city of Jujuy, though still a small place, has a complete system of educational institutions — public schools, normal schools, and a national college. It is connected with Buenos Ayres by railway. Other mining districts are: Province of Salta (area, 45,000 square miles; pop. 131,938), which produces kaolin, besides the minerals found in Jujuy; but hitherto less attention has been given to mining than to the cultivation of sugar-cane, tobacco, wheat, maize, and rice. Similarly the provinces of Catamarca, Rioja, and San Juan, which also border on Chile, have mountainous characteristics and abundant mineral products. Mining is the principal industry of San Luis. Especially interesting are the province and city of Tucumán — the former called "The Garden of the Republic," on account of the beauty of its scenery and the prosperity of its inhabitants; the latter, "The Cradle of the Republic," for the reason that the Congress which issued the declaration of independence held its sessions there. The products of this small province are oranges, lemons, timber, cheese, and leather; pop. 249,433. Other provinces that take their characteristics from the great plains (Pampas) are: Santiago del Estro (pop. 180,612), which has

but one hill in all its 31,500 square miles; Santa Fé (pop. 523,236, one third foreign), which also controls most of the export and import trade of the provinces north of Buenos Ayres. Its principal city is Rosario on the Paraná River. The province of Mendoza (pop. 141,431), is mountainous in its western part, with rich plains in the centre and east. Its products are wines, olives, grapes, figs, and the ordinary cereal crops. Oil wells have recently been discovered. In 1861 its capital was almost completely destroyed by an earthquake, and over 10,000 persons perished in the ruins. The new city of Mendoza has a national college, two normal schools, an agricultural school, and 20 public schools.

Rapid Industrial Development.— Up to the year 1875 Argentina's exports were limited to products of the pastoral industry, while the country was dependent upon other lands for all manufactured articles. But nearly all the important branches of human industry are represented in the period of development that began after the year just mentioned. To such an extent is this true that Argentina not only produces for home consumption a great variety of articles formerly imported, but actually exports such articles in large quantities. In Buenos Ayres alone there are nearly 8,000 industrial establishments, including those for spinning, for preparing hides, for working timber and metals, for cereals, for the manufacture of articles of glass and wax, chemical products, grocery products, liquors, cigars, etc. Factories for making chocolate have been started in various parts of the country, the product being so abundant and of such excellent quality that the importation of chocolate has almost ceased. Over 50,000 men are employed in the woodworking industry; 25,000 persons in the manufacture of boots and shoes; there are 17 hat factories, and cloth and underwear are produced at a number of mills.

Cattle and Sheep.— The greatest industry, however, is still the raising of cattle and sheep. Argentina has more sheep than Australia, and exports 240,000 tons of wool annually. In 1899 there were 22,000,000 cattle, 5,000,000 horses and mules, and 85,000,000 sheep distributed among the various provinces. The general exportation of cattle products in that year was valued at $115,547,000 gold, or more than 62 per cent of the total exports of the country. Argentina's chief meat market is England. The total value of all kinds of cattle was estimated at $1,136,780,411 in 1895, and since that time the horned cattle, horses, and sheep have increased in numbers and improved in quality through the importation of full-blooded animals from the first breeders of Europe and the United States. By the year 1902 the dairy industry had become important: there were 523 dairies with four or five thousand cows in the largest establishments, and 1,300 tons of butter were sent abroad, chiefly to England.

Grain.— Before the war with Paraguay, the people of Argentina imported nearly all their flour from Chile, but during that war farmers found a good market for their products, and the cultivation of grain was encouraged. Wheat is now one of the chief articles of export to Europe. Owing to exceptionally advantageous conditions Argentine crops of wheat and Indian corn represented a per capita production of 42.33 bushels, against 42 in the United States and Denmark, 30 in Canada, 23 in Sweden, 20 in Russia, 19 in France, and 8 in Great Britain. The value in gold of the various Argentine harvests in 1899 was: wheat, $95,000,000; Indian corn, $23,000,000; lucern, $90,000,000; flax, $27,000,000; vineyards, $9,500,000; sugar-cane, $4,750,000; tobacco, $3,900,000; other cultures, $21,560,000.

Immense forests, producing varieties of hard wood which are useful for building and cabinet-making, are found in the provinces of Santiago del Estero, Salta, Tucumán, and Corrientes, as well as on the national lands of Chaco, Formosa, and Misiones. During the years 1895–99 about 8,000 tons of wood were exported, while the production increased greatly during 1900. Exploitation of these wooded regions is facilitated by a system of rivers which all flow into Rio Paraná. Each season witnesses, not only the development of the standard industries which have been mentioned, but the establishment of new enterprises. Among the latter the silk-worm culture in Santa Fé province and the evaporated fruit-industry in Córdoba province may be mentioned as recent examples. The largest items among imports from the United States are agricultural implements (amounting to about $2,000,000 in 1902) and mineral oils, refined or manufactured. During the years 1896–1901, inclusive, the total values of exports to and from the United States were as follows:

Year	Imports from U. S.	Exports to U. S.
Year 1896,	Amt. $8,361,195	Amt. $7,072,825
" 1897,	" 5,942,912	" 14,759,730
" 1898,	" 8,066,573	" 5,723,969
" 1899,	" 12,378,866	" 6,164,961
" 1900,	" 14,852,813	" 8,441,495
" 1901,	" 13,174,140	" 9,950,862

The total foreign trade of Argentina is on a vastly greater scale. At the beginning of this century its exports to all countries (taking the average of several years) amounted to about $175,000,000 annually; its imports from all countries being about $114,000,000 annually. During the first six months of 1902, Argentina's total exports rose to $105,203,781, and the total value of imports was less than half that amount. These figures show, first, the relatively small interchange of products between the United States and Argentina, and, second, the enormous balance of trade in favor of the Argentine Republic.

Financial Situation.— The Bankers' Clearing House of Buenos Ayres in 1900 showed transactions aggregating 3,402,660,743.12 pesos (pesos = $0.965), although several of the banks do not settle their operations through the clearing house. The financial situation of the republic in 1901 was fairly encouraging, the government's receipts being $38,244,638 in gold and $62,341,306 in paper currency, and the expenditures somewhat less. On the last day of 1901, the consolidated interior debt amounted to $17,863,000 in gold and $83,610,983 in paper currency. The foreign debt amounted to $386,451,295 in gold, but of this total the sum of $46,000,000 was owed by individual provinces.

Marrion Wilcox,
Authority on Latin-America.

Ar'gentine, Kansas, a city in Wyandotte County, about three miles from Kansas City, on the Atchison, T. & St. Fe. R.R. It has extensive

smelting interests, and several grain elevators. Pop. (1900) 5,875.

Ar'gentine, the name of a group of small smelt-like fishes, living in the open seas of the north temperate zone, and distinguished by the brilliant, silvery appearance of their scales. Some ascend rivers to deposit their spawn, where they are caught in large quantities and eaten as a delicacy.

Argentite (from the Latin, *argentum*, "silver"), a native sulphide of silver, belonging in the galena group, crystallizing in the isometric system and having the formula Ag_2S. It is opaque and has a metallic lustre and a dark, leaden gray color. Its hardness is from 2 to 2.5, and its specific gravity is about 7.3. Argentite occurs in many countries and when found in quantity is a valuable ore of silver. It occurs in crystals (often distorted), massive, in crusts, and in thread-like aggregates. Choice specimens occur in the silver mines of Joachimsthal, Bohemia, and Freiberg, Saxony; in Bolivia, Chili, and Peru, and notably at Batopilas, Mexico; also in many silver mines in Colorado, Nevada, and elsewhere in the United States. Argentite is often called "silver glance" by miners.

Argentoratum, an Old Celtic word, meaning "atones of Argantos," the Old Roman name for Strasburg.

Ar'gilla'ceous Rocks, a petrographic division including those rocks that are largely composed of clay. They owe their origin to the disintegration and decomposition of other rocks and hence are always of secondary nature. Among the common varieties belonging to this class are ordinary brick-clay, fire-clay, potter's-clay, kaolin, mudstone, shale, and marl (qq.v.). Clay rocks are easily influenced by metamorphic agencies, yielding shale, mica-schist, graywacke, and other hard rocks. See SEDIMENTARY ROCKS.

Arginusæ, är'jĭ-nū'sē, the name of several small islands southeast of the Island of Lesbos, a province of Asia Minor. In their vicinity the Athenians, under Conon, 406 B.C., defeated the Spartans under Collicratidos, in a hard-contested naval battle.

Ar'gives, or **Argivi,** the inhabitants of Argos; a term used by Homer and other ancient authors as a generic appellation for all Greeks.

Ar'go, the important southern constellation of the Ship, which is nearly 75 degrees in length, and contains over 800 stars visible to the naked eye.

Ar'go. See ARGONAUTS.

Argob, the name of a district in Bashan, referred to in Deut. iii. 4, as the kingdom of Og, and containing threescore walled cities. Its precise location has not been determined.

Ar'gol (origin of the word unknown), a term applied to the crude acid tartrate (or bitartrate) of potassium, as deposited on the sides of the vats in which wine is fermenting. It exists in the grapes from which the wine is made, but is precipitated from solution in the vats by the alcohol formed during the fermentation. Like many other precipitates, argol brings down more or less of the coloring matter in the solution from which it is deposited, and it is white or red, according to the color of the wine from which it is formed. When purified by re-crystallization from its solution in hot water, argol is known in commerce as "cream of tartar." The purified salt is extensively used in baking powders and to a lesser extent in medicine.

Ar'golis, a peninsular state of ancient Greece; between the bays of Nauplia and Ægina, now forming with Corinth, a monarchy or department. Argolis was the eastern region of Peloponnesus, and its inhabitants were often called Argives. According to the monuments of Greek mythology, Argolis was peculiarly rich, and early cultivated. Here reigned Pelops, an emigrant from Asia Minor, from whom the peninsula derives its name. It was afterward the seat of government of Atreus and Agamemnon, Adrastus, Eurystheus, and Diomedes. In the earliest times it was divided into the small kingdoms of Argos, Mycenæ, Tiryns, Trœzene, Hermione, and Epidaurus, which afterward formed free states. The chief city, Argos, has retained its name since 1800 B.C. Its inhabitants were renowned for their love of the fine arts, particularly of music. Some vestiges remain of its ancient splendor, and it has at present about 9,000 inhabitants. Near it is the capital of Argolis, Nauplia, or Napoli di Romania, with an excellent harbor, and the most important fortress of the peninsula. On the site of the present village of Castri, on the Ægean Sea, formerly lay the city Hermione; opposite is the island of Hydra. Pop. of province of Argolis and Corinth (1896) 157,578.

Ar'gon (Greek, "inactive," in allusion to its entire lack of chemical affinity), a gaseous substance, presumably an element, discovered in the earth's atmosphere in 1894 by Lord Rayleigh and Prof. William Ramsay. For some years previous to this discovery, Lord Rayleigh had been engaged in a careful determination of the densities of certain gases, and consistent results had been obtained for all of them save nitrogen. This gas, when prepared from air by the abstraction of all other known components, was found to be heavier by about one part in 200, than the nitrogen prepared from ammonia. There could be no doubt about the reality of the difference, because the same experimental methods, when applied to other gases, gave results that were consistent with one another to about one part in 10,000. In studying the cause of the discrepancy, Lord Rayleigh prepared nitrogen from ammonium nitrite, from urea, and from nitric and nitrous oxides: and found that all specimens of the gas that were prepared from nitrogen compounds agree with one another in density, but that the specimens of nitrogen that he prepared from air were uniformly and consistently heavier, by the same constant amount of one part in 200. Provisionally, therefore, he recognized two kinds of nitrogen, which he called "chemical nitrogen" and "atmospheric nitrogen," respectively, to indicate the sources whence they were obtained. He then published a letter in 'Nature,' narrating these facts, and calling for suggestions from chemists as to the cause of the systematic difference in density. No ideas of value were elicited. The possibility that

"chemical" nitrogen might be contaminated with hydrogen, and that the experimental methods failed to eliminate the last traces of this very light gas, was tested by adding hydrogen to "atmospheric" nitrogen, and then submitting the mixture to the same process employed for removing any hydrogen that might have existed in the "chemical" nitrogen. If the hydrogen theory of the discrepancy had been true, it would have been found that "atmospheric" nitrogen, when treated in this way, would ultimately agree in density with "chemical" nitrogen; but the test showed that "atmospheric" nitrogen, after the addition and subsequent removal of hydrogen, returned to its original state of higher density, thus proving the adequacy of the experimental methods, and disproving the hypothesis that the difference in density was due to hydrogen. The suggestion was also made that the "atmospheric" nitrogen had partly polymerized into an allotropic state analogous to ozone, or that the "chemical" nitrogen had partially dissociated into monatomic molecules. These possibilities were tested by subjecting both kinds of nitrogen to the action of the silent electric discharge, in an apparatus designed for the production of ozone from oxygen. It would certainly be expected that the difference in density would partially or wholly disappear under this treatment if there were any basis to the polymerization or dissociation hypotheses; but it was found that both kinds of nitrogen retained their initial densities, so that the original difference persisted undiminished in amount. Furthermore, if the lightness of "chemical" nitrogen were due to a partial dissociation induced by the method of preparation, it would be reasonable to expect that the molecules would re-combine in time with a resulting return of the density to that observed in "atmospheric" nitrogen. Specimens of "chemical" nitrogen that were allowed to stand for eight months, however, were found to retain their characteristic lightness. At this stage in the investigation, Prof. Ramsay asked permission to co-operate in the investigation, and his services were gladly accepted. The hypothesis was made that "chemical" nitrogen contains an unknown gas, *lighter* than true nitrogen; or that "atmospheric" nitrogen contains some similar gas that is *heavier* than true nitrogen. In spite of the many analyses that had been made of the air, it was thought more probable that the unknown gas would be found in "atmospheric" than in "chemical" nitrogen; and hence the experimenters turned their attention to the problem of removing "true" nitrogen from the "atmospheric" nitrogen, with the idea of obtaining a possible residuum, which would at least contain the unknown gas in concentrated form. For this purpose it was proposed to take advantage of the known fact that at a red heat nitrogen will combine with metallic magnesium, with the formation of magnesium nitride. "Atmospheric" nitrogen, carefully freed from all known impurities, was therefore passed through a long tube of hard glass filled with magnesium shavings and heated in a furnace. The first experiment of this sort was made in May 1894, and gave encouraging results, the "atmospheric" nitrogen showing a slight but unmistakable increase in density. A more elaborate experiment of the same sort followed, in which "atmospheric" nitrogen was caused to pass over hot magnesium for more than two weeks. By this means its density, originally about 14 (that of hydrogen being 1), was increased to 19.09, and the bulk of the gas under examination was diminished until not much more than one per cent of it remained. Plainly a great concentration of the unknown gas has been effected. To remove the last traces of true nitrogen, pure oxygen was next added, and the mixture exposed to a rain of electric sparks in the presence of caustic soda. When so treated the experimental gas contracted, indicating that the nitrogen was being withdrawn in the form of nitrate of sodium. When contraction was no longer noted, the nitrate of sodium and the excess of oxygen were removed, and it was found that the remaining gas had a density about 20 times as great as that of hydrogen. When subjected to the electric spark and examined by the spectroscope, this residual gas was found to exhibit certain characteristic groups of red and green lines that did not correspond to any element previously known. The experimenters, therefore, felt reasonably sure that a new element had been discovered, and this conclusion has been borne out by all subsequent investigations. The discovery of this element (to which the name "argon" and the chemical symbol "A" have been assigned), was formally announced to the public in Aug. 1895, and for it Lord Rayleigh and Prof. Ramsay were awarded the Hodgkins prize and also the grand prize of the Smithsonian Institution. See Air.

As it was found that air contains 0.937 of one per cent (by volume) of argon, it is natural to ask why the new element had escaped detection in the vast number of air-analyses that have been made in the past. The answer is that argon shows no chemical affinity whatever, and as nitrogen is also inert in comparison with most elements, the two were very easily confused. Chemists have almost invariably estimated the nitrogen of the air "by difference"; that is, by removing all such constituents as oxygen, carbon dioxid, and ammonia, and taking it for granted that the inert remainder is nitrogen. It might be thought that the spectroscope would betray the presence of argon, when the spectra of "atmospheric" and "chemical" nitrogen were compared; but the curious fact has been established that when argon and nitrogen are mixed, the argon does not reveal itself to the spectroscope unless the mixture contains at least 37 per cent of argon. Upon looking over the work that had been previously done upon air, it was found that Cavendish had isolated nearly pure argon as long ago as 1785, but without recognizing its real nature. Thus, knowing that air contains a considerable quantity of nitrogen, he raised the question whether all of the apparently nitrogenous part of the air "could be reduced to nitrous acid, or whether there was not a part of a different nature from the rest which would refuse to undergo that change." To decide this point he added excess of oxygen to air and passed electric sparks through the mixture (precisely as Rayleigh and Ramsay did) until no further diminution of volume occurred. He then removed the excess of oxygen, together with the oxids of nitrogen that had been formed, and found that only a small bubble remained unabsorbed, which, he says, was not more than

one one hundred and twentieth of the bulk of the original nitrogen. The bubble that he thus obtained and whose nature he did not further question must have been nearly pure argon.

Argon having been discovered, chemists at once undertook to ascertain its chemical properties, but here they met with an obstacle that has not yet been overcome, and which constitutes one of the strangest facts known to chemistry. It was found, namely, that argon cannot be made to enter into chemical combination with any substance whatsoever. Thus Rayleigh and Ramsay have stated that "argon does not combine with oxygen in presence of alkali under the influence of the electric discharge, nor with hydrogen in presence of acid or alkali, nor when sparked, nor with phosphorus at a bright red heat, nor with sulphur. Tellurium may be distilled in it and also sodium and potassium. Red hot sodium peroxid has no effect. Persulphids of sodium and calcium have no effect at a red heat. Platinum sponge does not absorb it. Aqua regia, bromine water, bromine and alkali, and potassium permanganate are all without influence. Mixtures of metallic sodium and silica, or of sodium and boric acid, are likewise without influence, and hence also nascent silicon and boron." Moissan further found that fluorin does not act upon it at any temperature. In short, it may be said that every reagent that the previous experience of chemists indicated as likely to combine with argon has been tried without success, and hence the chemical properties of the element (if, indeed, it has any such properties), are as yet quite unknown. Several announcements of the existence of compounds of argon have been made, but no really convincing evidence of such combination has been given. For example, Berthollet subjected a mixture of argon and benzene to the action of the silent electric discharge for a long time, and observed a diminution in the volume of the argon, which he attributed to its combination with the benzene. Benzene when treated in this way forms a resinous mass, which coats the walls of the tube, and it is not improbable that the small quantity of argon which disappears is held mechanically by the gummy deposit, either in solution or by absorption. At all events the original quantity of argon is restored, unchanged, by heating the resin. It cannot be positively affirmed that no compound of argon exists, but there is no previously known element (not even the metals of the platinum group) that could withstand the action of the substances whose activity has been exerted without effect upon argon. The only promising result that has yet been reached is that announced by Villard, who states that at 32° F., and at a pressure of 150 atmospheres, argon forms a crystalline hydrate with water, which dissociates again into argon and water at a pressure of 105 atmospheres. Even this result requires confirmation, since Villard did not really prove the presence of argon in the crystals that he obtained. Until some compound can be formed we shall therefore have to infer the atomic weight of argon from determinations of the density of the gas, taken in connection with Avogadro's law. The best determinations made up to the present time indicate that the density of argon is 19.80 times that of hydrogen. If the molecules of argon are diatomic, then 19.80 is the atomic weight of the element, but if they are monatomic, we must double this estimate and conclude that the atomic weight is 39.60. (See ATOMIC THEORY; also GASES, KINETIC THEORY OF.) To settle this doubtful point experiments were made to find the ratio of the two specific heats of the gas, and it was found that the specific heat of argon at constant pressure is about 1.65 times as great as the specific heat at constant volume. This indicates that the molecule of the gas contains but one atom, and hence it is necessary to conclude that the atomic weight of argon is 39.60, the atomic weight of hydrogen being taken as 1. Argon has been liquefied and solidified. Its critical temperature is 179° F. below zero, and its critical pressure is about 52.9 atmospheres. Liquid argon boils (under ordinary atmospheric pressure) at about 303° F. below zero, and at about 306° below zero it freezes. The density of liquid argon is about 1.212 times as great as that of water. Four other elements, associated with argon in the air and closely resembling it in properties, have been discovered as the result of researches suggested by the discovery of argon. They are called, respectively, helium, neon, krypton, and xenon (qq.v.). Hundreds of papers dealing with argon and the other gases just mentioned have appeared in the scientific periodicals, so that no bibliography of the subject can be attempted here. Ramsay's book, 'The Gases of the Atmosphere' (1896) gives an excellent account of the chemistry of the air, from the earliest times down to 1896. It must be remembered, however, that our knowledge of argon and its allies is growing rapidly, so that some of the statements that Ramsay makes can be no longer admitted to be true. For example, he states that helium (which had already been discovered when his book was written) does not occur in the air, but it has since been shown that it *is* a component of the air, forming from one to two one millionths of its bulk. Travers' 'The Experimental Study of Gases' may also be consulted with advantage.

Ar'gonaut, the appellation of an eight-armed oceanic cephalopod, closely allied to the octopus, and having the same power of swimming backward by forcing water through its funnel. Though called "paper nautilus" is is entirely different from the true nautilus (q.v.), and although, since the earliest days, it has been said to sail upon the surface of the ocean, in its shell as a boat, with two web-like arms spread for sails, this belief is pure fable. Argonauts remain in deep water except in spawning season, and then come to the surface only at night. The male is a naked octopod, and the "boat" of the female has no organic connection with her body, but is a mere receptacle for holding eggs, retained in place by the two dorsal arms, which are membranous and secrete it from their inner surfaces. It is not chambered like that of the true nautilus, but has a radially fluted, semi-transparent spiral shell, enveloping the body as far as the base of the tentacles, increasing in size with the growth of the animal, and attaining a length of six inches. The male is only about an inch in length; one of its very short arms is specialized into an organ of generation, called a "hectocotyle," which detaches itself from the male body, and, having independent locomotory powers, attaches itself to the

female, and in some manner unknown fertilizes the eggs. Only a single species is known (*A. hians*), representing the family *Argonautidæ*. See NAUTILUS.

Ar'gonauts, the name given in Greek legends to the sailors, who, in a ship called the Argo, made a hazardous voyage to Colchis under the leadership of Jason, in quest of the golden fleece. Jason's uncle Pelias had usurped the kingdom of Iolcos and would resign it only on condition that Jason should first bring from Colchis the golden fleece suspended in a consecrated grove at Colchis. Among Jason's companions were Hercules, Castor and Pollux, Peleus, Admetus, Meleager, Orpheus, Telamon, Theseus, and his friend Pirithous, Hylas, and Lynceus. Having sailed from the promontory of Magnesia, in Thessaly, they reached the harbor of Lemnos, where they remained two years. The women of Lemnos, instigated by the offended Aphrodite (Venus), had slain all the males among them, except Thoas, and they detained among them the welcome strangers. At length they proceeded to the Troad, where Hylas and Hercules were left behind. After various adventures they approached the dreaded Symplegades, rocks which closed together and dashed in pieces vessels passing through them. According to instructions previously received, they caused a dove to fly through before them, and followed, rowing with all their strength, while Orpheus played on his lyre. The rocks stood firm, and the danger was escaped. The last adventure awaited them at the Island of Aretias. Here they found the Stymphalides, birds which shot their feathers like arrows, and from which the heroes could only protect themselves by a violent clashing of weapons. On their arrival at Colchis King Æetes did not refuse absolutely to deliver the golden fleece, but charged Jason with three dangerous labors, thus hoping to destroy him. Jason was to yoke the two fire-breathing bulls of Hephæstus to a ploughshare of adamant, and to plough with them four acres of land consecrated to Ares (Mars), and never before turned up. He was then to sow in the furrows the remaining serpents' teeth of Cadmus, in the possession of Æetes, and to kill the armed heroes which they produced; at last, to fight with and slay the dragon that guarded the golden fleece. All three labors he was to accomplish in a single day. With the help of Medea, the daughter of Æetes, these tasks were accomplished and the fleece obtained. Jason then fled with Medea, but the fugitives were pursued and on the point of being overtaken when Medea averted the danger by killing her brother Absyrtus, and strewing on the road his mangled limbs. The unhappy father quitted the pursuit to collect the bloody limbs of his son and the fugitives escaped. The return of the Argonauts is variously told, but after many perils they reached Iolcos and gave the fleece to Pelias.

Argonauts of '49, a literary name (the colloquial one being «Forty-niners») applied to the California pioneers. The first discovery of gold was in January 1848, but it was not generally realized till April; from thence till the following winter California itself (recently obtained by the United States from Mexico) was partially depopulated outside the mining camps, even soldiers and sailors deserting in great numbers and rushing to the mines, while executive authority was paralyzed. These local changes of place, however, did not constitute a «voyage for the Golden Fleece» from far distant regions, which is what the term implies. The excitement, spread by official reports and intensified by journalistic inventions, had fully roused the East by winter; from January onward the great sea routes were thronged. By the end of the year the new province (it never was organized as a Territory, entering the Union as a State from a condition of legal nullity or permitted trespass) contained toward 100,000 people. The imperfect State census of 1852 showed 264,435, nearly all Argonauts proper.

Much the greater portion came by sea; the favored route being by the Isthmus of Panama. The passengers landed at Chagres, took boat up that river to Cruces, then crossed over by horse or mule conveyance to Panama, where they took such coasting steamers or sailing craft as came along. The crowds which flocked thither by all sorts of Atlantic vessels far outran the Pacific fleet's capacity, and large numbers had to wait many weary weeks for a passage. At one time 3,000 were collected at Panama, so wild with impatience that several small companies unsuccessfully attempted to make the voyage to San Francisco in the natives' log canoes. An assemblage of several hundred to a thousand was common; and at one time they enlivened the tedium by issuing a newspaper. But a far more terrible foe than ennui had to be faced: the cholera and Panama fever, which carried off great numbers of the emigrants and a quarter of the inhabitants of Panama. Before the excitement had begun, two new steamers, the California and Oregon, were assigned to this route to run monthly. The fare was $300, and the competition for space was so great that double price was sometimes paid. The California reached San Francisco on her first trip 28 Feb. 1849. When she came up the west coast after rounding the Horn to reach Panama, the gold fever had just reached Peru, and 75 Peruvians took passage. This preoccupation of space so enraged the 1,000 or so of waiting Americans that they induced the commandant of the United States forces in California, who was waiting with them, to issue a proclamation ejecting the Peruvians as intending trespassers on United States public lands not yet opened for settlement. As they refused to go, however, no one dared use force. In one case some 300 intending passengers drew lots for the 52 steamer tickets on sale. Many gold-seekers crossed at Nicaragua, at the isthmus of Tehuantepec, or at central Mexico. Many thousands, however, chose the cheaper and unbroken but time-wasting sailing voyage of several months around Cape Horn. The vessels on this route were miscellaneous and often unfit and ill manned; the food was poor and insufficient, and the voyage full of hardship. There was also a large overland emigration across the plains, through the Great Basin and its alkali deserts, and over the Coast Range. This journey, too, was full of suffering from lack of food, lack of water, lost trails, and exhaustion; and sometimes after a summer of endurance to the last gasp, the

pilgrims saw the snows close up the mountain passes before them, and either wintered or died on the eastern flank, or lost themselves trying to penetrate through the snow. This overland body had two strongly distinguishing marks from the immigrants by sea. First, it contained nearly all the families among the Argonauts, as distinguished from the solitary masculine adventurers; and therefore nearly all the women. Second, it was nearly all a Northern and free-labor element — an important point in the struggle to make new States free or slave then going on between the sections.

The characteristics of the Argonauts as a body were these: First, they were mostly men, with a few low-caste women, and their moral sense was not therefore quickened by the presence and needs of family life; though families and reputable women were by no means so utterly absent as the exaggerated myths of the old-timers would make it appear. Second, few intended to remain longer than was needed to acquire a fortune and return East. This did not make their settlement in the least less enduring or desirable; but with the paucity of family life, it prevented them for some time from feeling a proper responsibility for public order and the creation of solid institutions, and spasms of illegal violence were expected to do the work of steady legality. Third, they were from all sections of the country, at a time when North and South were daily becoming hostile races. Though the free-State people were largely in the ascendant, the Southerners were the political leaders and the State was steadily Democratic. Yet the former class had no idea of letting sectional politics rule their general action: home issues were too pressing and national ones too academic; and while California as a free State sympathized with and furnished splendid help to the Union, her politics have never been affected by the issues either of slavery or of reconstruction. Fourth, along with men of character and ability, since prominent as business and professional men, State officials, editors, etc., there were of course great numbers of blacklegs, desperadoes, and refugees from justice. These not only defied all law in their relations with each other, but frequently outraged, plundered, and murdered the native Spanish inhabitants, and required an amount of time and effort to keep them in order, which the decent element — who were in a great majority — were unwilling to give. Hence society again and again seemed on the verge of being dominated wholly by its criminal classes, and the fear of an occasional uprising of the orderly element did not countervail its being only occasional and the chance of escaping it. (See VIGILANCE COMMITTEES.) But the best praise which can be given to the essential soundness of the Argonauts is that in a remarkably short time they rose to the same sense of their responsibilities as older commonwealths, and the California of 1860 was not inferior to any of its companions. See Royce, 'History of California' (1891); H. H. Bancroft, 'History of California,' 4 vols. (1884–90); Shinn, 'Mining Camps' (1885); Bayard Taylor, 'Eldorado' (1850); Burnett, 'Reminiscences of an Old Pioneer' (1880).

Argonne, är'gŭn', a district of France, now contained in the departments of Marne and Ardennes. The wood of Argonne is celebrated for the campaign of Dumouriez against the Prussians in 1792, and was also the scene of several events in the Franco-Prussian war.

Ar'gos, an important city of ancient Greece. The conquest of Argos by the Dorians forms the first really authenticated event in its history. Argos was now a Doric city, though it retained with part of its Achæan population some of its ancient habits, particularly the worship of Hera (Juno). It had also a temple of peculiar sacredness to Apollo. It was long the first Dorian city in Greece, Sparta being the second, and Messene the third. From the time of the ascendency of Sparta, Argos was divided between a democratic and an oligarchic party, the former of which inclined to the Athenian, the latter to the Spartan alliance; but the general spirit of the city tended toward enmity to Sparta. In 362 Argos fought with Thebes against Sparta and Athens. The celebrated Pyrrhus was killed in an invasion of Argos in 272. In 229 Argos joined the Achaian League, to which it continued to adhere till its overthrow by the Romans. The town of Argos is a straggling modern place, with houses mostly surrounded by gardens, and few buildings of importance. The chief relic of the ancient city is the theatre. There is an acropolis, 1,000 feet high, crowned by a ruined castle. Pop. 10,000.

Argostoli, är'gŏs-tō'lę, an important city of the Ionian Islands, the capital of Cephalonia. Its harbor is considered the best in the Ionian Islands, and there are excellent quays. The town is the residence of a Greek bishop. Pop. (1890) 9,241.

Argot, är'gō', a French term denoting the jargon, or peculiar phraseology of a class or profession. It originally referred to the conventional slang of thieves and vagabonds, invented for the purpose of disguise and concealment.

Argout, är'goo', **Antoine Maurice Apollinaire, Count d',** a French statesman and financier: b. in Isère in 1782; d. in 1858. He was governor of the Bank of France, 1834–48.

Arguelles, är'gā'lyas, **Augustin,** a Spanish statesman: b. in Rivadisella in Asturias in 1776; d. in Madrid, 23 March 1844. On the outbreak of the war of independence in 1808 he attached himself to the patriotic party, and, as representative of his native province in the Cortes, gained a high reputation for eloquence (1812–14). On the restoration of Ferdinand VII., Arguelles was arrested, and suffered several years' imprisonment in the galleys till the revolution of 1820 restored him to freedom. On the fall of the Constitution (1823) he fled to England, where he remained till the amnesty of 1832. On his return to Spain, being nominated to the Cortes, he was repeatedly made president and vice-president of the Chamber of Deputies, and always showed himself a moderate but unwavering reformer.

Ar'gument, a term sometimes employed as synonymous with the subject of a discourse, but more frequently appropriated to any kind of method employed for the purpose of confuting or at least silencing an opponent. Logicians have reduced arguments to several distinct heads, of which the only one that can be said to have truth only for its object is the *argumen-*

tum ad judicium, founded on proof and addressed to the judgment. See LOGIC.

Ar'gument, a legal term applied to an address by counsel to the court or jury in which the merits of the client's case are set forth with reference to effect upon the verdict or decision which is to follow. See TRIAL.

Argun, är-goon', a river of northern Asia, an affluent of the Amur, and about 1,100 miles long.

Ar'gus, a personage represented in Greek mythology as having 100 eyes, or as having his whole body covered with eyes, half of these being always awake while the rest were closed in sleep. The jealous Hera made him keeper of the unhappy Io; but Hermes lulled him to sleep with the sound of his flute, and cut off his head. Hera afterward took his eyes to adorn the tail of the peacock. Argus was once considered a desirable name for a watch-dog.

Ar'gus Pheasant. See PHEASANT.

Argyle, är-gīl', **Campbells of**, the designation of a distinguished Scottish family. Among its most noted representatives are: ARCHIBALD, the second Earl, who was killed at the battle of Flodden, 1513. ARCHIBALD, fifth Earl, attached himself to the party of Mary of Guise, and was the means of averting a collision between the reformers and the French troops in 1559. He was commissioner of regency after Mary's abdication, but afterward commanded her troops at the battle of Langside, and died in 1575. ARCHIBALD, eighth Earl and Marquis, b. 1598, was a zealous partisan of the Covenanters, and was created a Marquis by Charles I. It was by his persuasion that Charles II. visited Scotland, and was crowned at Scone in 1651. At the restoration he was committed to the tower, and afterward sent to Scotland, where he was tried for high treason, and beheaded in 1661. ARCHIBALD, ninth Earl, son of the preceding, served the king with great bravery at the battle of Dunbar, and was accordingly excluded from the general pardon by Cromwell in 1654. On the passing of the Test Act in 1681 he refused to take the required oath except with a reservation. For this he was tried and sentenced to death. He, however, escaped to Holland, whence he returned with a view of aiding the Duke of Monmouth. His plan, however, failed, and he was taken and conveyed to Edinburgh, where he was beheaded in 1685. ARCHIBALD, tenth Earl and first Duke, son of the preceding, died in 1703. He took an active part in the revolution of 1688–9, which placed William and Mary on the throne, and was rewarded by several important appointments and the title of Duke. John, second Duke and Duke of Greenwich, son of the above, was born in 1678 and died in 1743. He served under Marlborough at the battles of Ramilies, Oudenarde, and Malplaquet, and assisted at the sieges of Lisle and Ghent. He incurred considerable odium in Scotland for his efforts in promoting the union. In 1715 he fought an indecisive battle with the Earl of Mar's army at Sheriffmuir, near Dunblane, and forced the pretender to quit the kingdom. He was long a supporter of Walpole, but his political career was full of intrigue. He is the Duke of Argyle who appears in Scott's 'Heart of Midlothian.' GEORGE JOHN DOUGLASS CAMPBELL, eighth Duke, Baron Sundridge and Hamilton, was born in 1823 and died 24 April 1900. He early took a part in politics, especially in discussions regarding the Presbyterian Church of Scotland. In 1852 he became lord privy seal under Lord Aberdeen, and again under Lord Palmerston, in 1859; postmaster-general in 1860; secretary for India from 1868 to 1874; again Lord privy seal in 1880, but retired, being unable to agree with his colleagues on their Irish policy. He was the author of 'The Reign of Law' (1866); 'Primeval Man' (1869); 'The Burdens of Belief' (1894); 'Organic Evolution' (1878). JOHN DOUGLAS SUTHERLAND, ninth Duke, eldest son of the preceding, was born in 1845. He married Louise, the fourth daughter of Queen Victoria, in 1871, and as Marquis of Lorne was governor-general of Canada 1878–83. He succeeded to his present title in 1900. He is the author of 'A Trip to the Tropics' (1867); 'Guido and Lita' (1875); 'The Psalms Literally Rendered in Verse' (1877); 'Canadian Pictures' (1885); 'Imperial Federation' (1885).

Argyllshire, är-gīl'shĭr, an important county in the highlands of Scotland, consisting partly of mainland and partly of islands belonging to the Hebrides group. The area is 3,213 square miles, or 2,056,400 acres. The greatest length of mainland is about 115 miles. From the windings of the numerous bays and creeks with which the land is everywhere indented it is supposed to have more than 600 miles of sea-coast. The chief towns are: the capital, Inverary, Campbeltown, Oban, Dunoon, Lochgilphead, and Tobermory. For a long time this county scarcely formed part of the kingdom, being subject to the Macdonalds of the isles, who assumed regal and independent sway over it. The estates, titles, and jurisdiction of the latter, however, subsequently fell to the Campbells, whose present representatives, the Duke of Argyle and the Earl of Breadalbane, are the chief landed proprietors.

The chief articles of export are sheep, cattle, horses, fish, slate, and granite. One of the most important branches of industry is the fishing of herring, cod, and ling, which abound on the coast and around the islands. The principal manufactures are whisky and coarse woolens. A great impulse has been given to the prosperity of the county by the extension of steam navigation. Among the antiquities of Argyllshire are the celebrated monastery of Iona, and the remains of a Cistercian priory in Oronsay. The most noted of its natural curiosities are the basaltic columns and cave of Staffa (q.v.) Pop. (1901) 73,665.

Argy'ria, or **Silver Poisoning.** See TOXICOLOGY.

Argyro-Castro, är'gē-rō-käs'trō (Turkish Ergree-Kastree), a town of Albania, 50 miles northwest of Janina. It is picturesquely situated on an elevated rocky site intersected by deep ravines and overlooked by a dilapidated castle. Turkish snuff is manufactured here.

Argyr'odite (Greek, "like silver"), a mineral first observed at Freiberg, Saxony, and found upon analysis to contain a previously unknown metallic element, to which the name "germanium" has been given. Argyrodite has the formula $4Ag_2S.GeS_2$, and crystallizes in the isometric system. It has a hardness 2.5 and a specific gravity varying from 6.08 to 6.26. It has

a metallic lustre, and fresh fractures show a gray color tinged with red or violet. Its crystals are usually small and it also occurs massive. Large crystals have been found in Bolivia.

Ari Thorgilsson, ä'rẹ-tôr'gẹl-sōn, the father of Icelandic literature: b. in 1067; d. in 1148. He was the first Icelander to use his mother tongue as a literary medium. His 'Islendingabók,' a concise history of Iceland from its settlement (about 870) until 1120 is preserved only in an abstract. Later Icelandic writers modeled their style upon his.

Aria, ä'rẹ-ạ or ā'rĭa, a term in music. See Air.

A'riad'ne, the daughter of Minos, king of Crete, who, having fallen in love with Theseus when engaged in his attempt to destroy the Minotaur, gave him a clue of thread, which served to guide him out of the labyrinth after having slain the monster. Theseus, on leaving the island, took with him Ariadne, but deserted her on the Isle of Naxos.

A'rianism is the name given to the doctrine of the person of Christ advocated by Arius and his followers. It contained nothing essentially new, but it crystallized certain modes and tendencies of thought which had been more or less prevalent in the Church for three or four generations. (See Christology.) The views of Arius and the strict Arian party may be summarized as follows: (1) The Son was created out of nothing, and is therefore *different in essence* from the Father. He is Logos, Wisdom, Son of God, but so only by the *grace* of God and not in and of himself. (2) There was (before time began) when he was not; that is, he is a finite being. (3) He was created before everything else, and through him the universe was created and is administered. (4) The Logos became the soul of the historical Christ, and the human elements in the character of Jesus belonged to the Logos. (5) Although the incarnate Logos is finite and hence is not God, he is to be worshipped, since he is exalted far above all other creatures, and is both Ruler and Redeemer.

The discussions at the Nicene Council revealed the fact that there were three parties present: the strict Arians, the semi-Arians, and the Alexander-Athanasian party. The latter party with the help of Constantine and the western bishops, secured the adoption of a creed (see Creeds) which no strict Arian could subscribe to, since it declared that the Son is *identical in essence* (*homoousian*) with the Father. The semi-Arians, although they maintained that the Son was not *identical in essence*, but of *similar essence* (*homoiousian*) with the Father, were finally constrained to sign the document. Soon after the closing of the council the semi-Arians began to assail the Nicene creed, and finally, through the influence of Eusebius (q.v.), they secured the recall of Arius and his companions and the deposition and banishment of Athanasius. The sons of Constantine continued to favor the semi-Arian party, which included a large majority of the eastern bishops; but the western churches generally adhered to the Nicene creed. But the death of Constantius II. in 361, and the accession of Julian left the Arian party without imperial support, and Athanasius and his followers regained considerable influence in the east. The accession of Valens in 363, however, reversed the governmental policy and led to the fanatical persecution of the Nicenes. But the distracted condition of the Orient, due to the war with Persia, and the demoralized state of many of the bishoprics under Arian leadership, made it relatively easy for Theodosius the Great to espouse and support the Nicene party. A second œcumenical council held at Constantinople in 381 reaffirmed the Nicene creed with slight additions and curtailments, thus completing the victory of Nicara in favor of the full deity of the Son. Arianism was soon suppressed within the empire, but it continued for a long time to prevail among the barbarians. The conversion of Clovis, king of the Franks, to the orthodox faith in 496 was followed by a rapid decline of Arianism among the Teutonic peoples. See Arius.

Edwin Knox Mitchell,
Hartford Theological Seminary.

Ariano, ä'rẹ-ä'nō, an Italian town in the province of Avellino, 44 miles northeast of Naples, in one of the most frequented passes of the Apennines. It is the seat of a bishop, and contains a handsome cathedral. Pop. (1901) 17,650.

Arias, ā'rĭ-ăs, **Montanus Benedictus,** an Oriental scholar: b. Ferexenal, Spain, in 1527; d. there in 1598. He accompanied the Bishop of Segovia to the Council of Trent, and on his return secluded himself in a cloister among the mountains of Andalusia. Philip II. drew him forth from his seclusion to prepare a new edition of the Polyglot Bible, printed at Antwerp by the celebrated printers Plantin. Of his numerous writings the best known is his 'Jewish Antiquities,' attached to the Polyglot, and also published separately.

Arica, a-rē'kạ, a seaport of Chile, 30 miles south of the town of Tacna, with which it is connected by railway. It is still a port of some consequence, but has suffered much from earthquakes. During the war between Chile and Peru it was bombarded by the Chilean forces, and it passed into the possession of Chile in 1883. The chief exports are silver and silver ore, copper, bark, chinchilla skins, and alpaca wool. From this port the silver from the mines of Potosi used to be shipped for Europe. Pop. about 4,000.

Arimathea, a town in Judea and, according to Saint Jerome, not far from Lydda. It is mentioned in the Gospels as the home of Joseph, a member of the Sanhedrin, who had the honor of giving the burial place for the body of the crucified Christ. Joseph of Arimathea is also mentioned in the Arthurian legends as having brought the Holy Grail from Jerusalem.

Ar'icite, a mineral more correctly known as Gismondite (q.v.).

Ar'id Lands. See Deserts.

Ariege, ä'rẹ-āzh', a French department, separated from Spain by the Pyrenees. The arable land is small in quantity, but a considerable number of sheep and cattle are reared. The manufacturing industry is considerable, but lead, copper, etc., are abundant. The chief town is Foix. Area, 1890 square miles; pop. (1901) 210,527.

Ariosto, Ludovico, an Italian poet: b. Reggio 8 Sept. 1474; d. Ferrara 6 June 1533. His father, who was commander of the citadel of Reggio, proposed that he should study law, but, as he showed no indication of being fitted for this profession, he was finally permitted to follow his own inclinations. These led him to the study of literature, especially the classics, and he soon developed so much ability as a poet that, as early as 1495, he wrote several comedies. Two of them were acted about 1512, and they attracted the attention of Cardinal Ippolito d' Este, who sent him as an ambassador to the court of Pope Julius II. In 1517 he offended the cardinal by refusing to accompany him to Hungary, but he immediately entered the service of Alfonso, Duke of Ferrara, by whom he was appointed governor of Garfagnana, a position which he filled successfully for several years. The last years of his life were spent in writing comedies and in completing his principal work, a romantic epic, 'Orlando Furioso,' which has been called "the greatest poem of its kind in any language." His 'Satires' in the Horatian style were not published until after his death.

Ar'isti'des the Just, an Athenian statesman: b. near the middle of the 6th century B.C.; d. about 468 B.C. He was one of the ten generals of the Athenians when they fought against the Persians at Marathon, 490 B.C. According to the usual arrangement the command of the army was held by each of the generals in rotation for one day. But Aristides prevailed on his colleagues each to give up his day to Miltiades; and to this, in a great measure, must be ascribed the victory of the Greeks.

Aristides, Quintilianus, a famous Greek grammarian of the 1st century whose treatise on music is esteemed the most valuable of all ancient writings upon that theme.

Aristip'pus, a disciple of Socrates, and founder of a philosophical school among the Greeks, which was called the Cyrenaic, from his native city Cyrēnē, in Africa; flourished 380 B.C. His moral philosophy differed widely from that of Socrates, and was a science of refined voluptuousness. His fundamental principles were — that all human sensations may be reduced to two, pleasure and pain. Pleasure is a gentle, and pain a violent emotion. All living beings seek the former and avoid the latter. Happiness is nothing but a continued pleasure, composed of separate gratifications.

Aristolochia, a-rĭs'tō-lō-kī'a, a term denoting the type genus of plants of the natural order *Aristolochiaceæ*. The order includes nearly 200 species, mainly shrubs (some climbing), and herbs, natives of warm countries and especially numerous in tropical South America. *A. Sipho* (*macrophylla* of some botanists), the Dutchman's pipe or pipe vine, a native of the southeastern States, is perhaps the best known species grown in America. It is hardy as far north as Detroit. *A. californica*, a silky-haired Californian species with U-shaped flowers, and *A. tomentosa*, a small very hairy species with yellow flowers, found from North Carolina to Missouri and southward, are also grown out of doors to some extent. *A. clematitis*, the common birthwort, a perennial herb, is a European common weed as far north as latitude 50°, and, like *A. rotunda* and *A. longa*, two other herbaceous species, native to southern Europe, was formerly believed to be of service in childbirth, and the latter are still believed to be valuable as emmenagogues.

Ar'istoph'anes, the greatest of the Greek comic dramatists: b. in Athens probably about the year 448 B.C.; d. about 385 B.C. He appeared as a poet in 427 B.C., and having indulged himself in some sarcasms on the powerful demagogue Cleon was accused by the latter of having unlawfully assumed the title of an Athenian citizen. The same accusation was twice renewed against him, but he succeeded in repelling it both times. In 424 he again attacked Cleon in his comedy of 'The Knights,' in which he himself acted the part of the Athenian demagogue, because no actor had the courage to do so. The earliest of his extant plays was 'The Acharnians,' which was brought out in 425. Aristophanes was distinguished among the ancients by the appellation of "The Comedian," as Homer was by that of "The Poet." Of 54 comedies by him only 11 remain; but in order fully to enjoy them, and not to be offended by the extravagances and indecencies with which they are bound, we must be intimately acquainted with ancient customs and opinions. The purity and elegance of his language, which is regarded as a model of the Attic Greek dialect, the skill and care displayed in the plan and execution of his pieces, the wealth of lyric power displayed in his choral odes as well as the overflowing richness of his comic genius, and the various other excellences of his dramas, have gained for Aristophanes the fame of a master. His wit and humor are as inexhaustible as his boldness unrestrained. The Greeks were enchanted with the grace and refinement of his writings; and Plato, the comedian, said the Graces would have chosen his soul for their habitation. On both political and moral grounds he was a strong advocate for ancient discipline, manners, doctrines, and art; hence his sallies against Socrates in 'The Clouds,' and against Euripides in 'The Frogs' and other comedies. The freedom of ancient comedy allowed an unbounded degree of personal satire, and nothing which offered a weak side escaped his ridicule. He feared the Athenian populace so little that he personated them under the figure of a wretched old man called Demos. He incessantly reproached them for their fickleness, their levity, their love of flattery, their foolish credulity, and their readiness to entertain extravagant hopes. Instead of being irritated, the Athenians rewarded him with a crown from the sacred olive-tree, at that time considered an extraordinary mark of distinction. Aristophanes produced, under the name of his eldest son, the 'Cocalus,' his last play. With this what is known as the "middle" comedy began, to be followed afterward by the "new." The names of his extant plays are 'The Acharnians' (425 B.C.); 'The Knights' (424); 'The Clouds' (423); 'The Wasps' (422); 'The Peace' (421); 'The Birds' (414); 'Lysistrata' (411); 'Thesmophoriazusæ,' 'The Frogs' (405); 'Ecclesiasuzæ' (393); 'Plutus' (388). Among editions of his comedies may be mentioned those of Bergk (1867); Blaydes (1886); Holden (1887). English translations of excellence are those by Frere, Mitchell, Rogers, and Kennedy.

Aristophanes of Byzantium, Greek grammarian: b. about 262 B.C.; d. about 185. He was educated at Alexandria, and became the chief librarian of the great Alexandrian library. Ancient critics rank him among the most celebrated critics and grammarians. He deserves great credit for his services to the Greek language and literature. With Aristarchus, he was the principal expert in determining the so-called Alexandrian canon of the classical writers of Greece. He invented a series of critical signs, and greatly improved the notation employed in prosody, including accent, quantity, and breathing. His publications include important critical editions of Greek writers, particularly of Homer — the first of its kind — Hesiod, and the lyricists Alcæus and Pindar. For the plays of the tragic and comic poets he wrote introductions. Little of what he wrote is extant, save fragments in the scholia of the poets, some *argumenta* to the dramatic writers, and a part of the Λέξεις ('Glossary'). Consult Nauck, 'Aristophanis Byzantii Fragmenta' (1848).

Aristophanes (THE ENGLISH), a name frequently applied to Samuel Foote (q.v.), also called "The Modern Aristophanes," because of his abundant good spirits and skill in unsparing ridicule. Garrick was a common object of his wit.

Aristophanes (THE FRENCH), a name sometimes applied to the French dramatist, J. B. P. Molière (q.v.).

Aristophanes' Apology, a poem by Robert Browning (q.v.), published in 1875; the title being in full, 'Aristophanes' Apology; Including a Transcript from Euripides: Being the Last Adventure of Balaustion.' It is a sequel to the poem 'Balaustion's Adventure.' A long work in blank verse, it commemorates the defence made by Aristophanes of his comic art, on learning through Sophocles of the death of Euripides, the tragedian. An extensive article on it may be found in Berdoe's 'Browning Cyclopædia' (1892), with a glossary of terms, etc.

Aristotelianism. Aristotle is the first philosophical writer to make a strict separation of the branches of philosophy. His writings, in terms of their subject matter, fall into the following groups: Logic, Metaphysics, Physics, Ethics, Politics, and the Philosophy of Art. A classification made by Aristotle, but not applied to the arrangement of his writings, is: (1) theoretic philosophy; (2) philosophy of conduct; (3) philosophy of production, that is, of art. The analysis of the problems and subject matter of philosophy and science begins with him. In Plato's writings the various problems are fused together and treated integrally and synthetically in an ethico-metaphysical system.

Logic.— For Aristotle logic is a methodology of science, a propædeutic to the other disciplines. It is not strictly a science, because science has some essence or aspect of reality for its subject matter, while logic is concerned with the forms of knowing. Formal logic was founded by Aristotle and almost completely developed by him. Its chief feature is the doctrine of the syllogism, the process of reaching scientific or apodictic conclusions. The syllogistic process is a deductive process, that is, it derives particular conclusions from general principles or accepted premises. The possibility of deriving such conclusions rests upon the axiomatic principles of contradiction and the excluded middle, that is, two contradictories cannot at the same time and in the same reference be true; and of two contradictory propositions, one must be true and the other false, and a third intermediate proposition is excluded. The logical treatises were grouped together by Aristotle's successors and called the Organon or instrument of science. The several treatises consist of the Categories, the Hermeneutics, the Analytics, and the Topics. The Categories discuss simple terms; the Hermaneutics discuss the combination of terms with a predicate, that is, the judgment or proposition; and the Analytics and Topics discuss the combination of propositions in the syllogism. The syllogistic conclusion is the derivation of one judgment from another by means of a middle term. The notion, judgment and conclusion are the three elements with which formal logic operates. The categories, or general notions under which reality is viewed are enumerated by Aristotle as substance, quantity, quality, relation, place, time, position, possession, action, passion. These ten categories are evidently not derived from any single principle and are neither exhaustive nor mutually exclusive. Aristotle's main interest is in the syllogism; simple terms or notions and the judgment are scantily treated. His treatment of the syllogism is practically exhaustive. Modern logic has supplemented his work by adding to his theory of the categorical conclusion, which was his chief interest, the theory of hypothetical and disjunctive conclusions; further, by adding a fourth figure to his three, and lastly by developing the theory of inductive logic and the method of the sciences. Aristotle regards deductive logic as the only method that can furnish demonstration or apodictic conclusions. Science, however, would not be possible with syllogistic demonstration alone, for if all our premises had to be proven we should be forced into an endless regress. Therefore, science must accept certain fundamental principles as its axiomatic postulates. From these accepted postulates scientific proof proceeds by deduction. In addition to this Aristotle mentions the further method of induction without elaborating it, saying, however, that universal principles are secured by it from particular instances and that it has the advantage over deduction by being nearer to our sense experience and therefore more generally intelligible. On the other hand, he insists that a complete knowledge of particulars is necessary to a completely certain induction and this, owing to the multiplicity of particulars, being rarely possible, induction lacks in its conclusions the cogency of the deductive syllogism.

Metaphysics.— First Philosophy (the term Metaphysics is not used by Aristotle, but is a word applied to the First Philosophy on account of its being placed after the treatises on Physics by the early editor of the works) is the philosophy of first principles as such; second philosophy or physics is the philosophy of these principles applied to concrete phenomena, the phenomena of motion and matter. Aristotle is a disciple of Plato and, like his master, he viewed the world from the standpoint of teleology. The cosmic processes are determined by final causes. He makes more of facts than Plato does, has a much larger mass of empirical data for his constructions and is more catholic in his scientific interests. His metaphysics, however, like

Plato's, is based on high speculative ideas and he explains the world-order by means of these general and ultimate principles, so that he is not a realist in the sense of confining reality merely to particular facts. Like Plato, he sought the essence of phenomena in the concept and law, but unlike Plato he sought it in a concept given in the phenomena as their inner principle of development and not in a transcendent principle. If there is no concept or universal there can be no scientific knowledge. The concept is not, however, an idea isolated from particular things, but as the universal reality it is immanent in particulars (*universalia in re* not *ante rem*), the individual being the only self-existent real. Against Plato's doctrine of ideas Aristotle brings the following criticisms: (1) The Platonists furnish no adequate proof of the existence of ideas as hypostasized entities; (2) The Platonic ideas, because transcendent, cannot explain the phenomenal world, which is left without a principle of motion; (3) The world of ideas is only a reduplication of the world of sense in its generic aspect; (4) The explanation of the relation of the ideal to the sensible world by the terms archetype, pattern, image, etc., is only metaphorical. The universal is real as the formative principle in things, giving to them their generic character, while matter is the principle of individuality. Form and matter are explanatory of genus and individual. In every particular thing, with the exception of God or the Prime Mover (who is pure form), the two principles of form and matter are present; form making the classification of things and scientific knowledge possible, and matter making possible the concreteness of objects. Form and matter are two aspects of individual things and are not really, but only notionally, separable. Everything is both form and substrate, idea and matter, significance and stuff, soul and body, with the single exception of the Supreme Being. Form is the moving principle of development and matter is the passive potentiality. Plastic stuff or matter is moulded after generic patterns. In nature's processes Aristotle calls them energy and potentiality. The real is an explication of a prior potential. The transition of a thing from a condition of potentiality to a condition of actuality is accomplished by some form of motion. Motion in turn (which is of several kinds: spatial, that is, locomotion; qualitative, that is, transmutation of substances; quantitative, that is, growth) implies a moving cause, and any given moving cause an antecedent cause and so the causal regress would be endless, were we not to posit a Prime Mover or uncaused First Cause. The First Cause is the origin and source of all motion and life. As motion is eternal, so the Prime Mover is eternal; it is also immaterial, passionless, and motionless, for the Prime Mover causes motion merely as an ideal toward which matter strives in the processes of nature, analogously to the power of attraction in beauty. The activity of God is pure thought or thought turned upon itself, which theoretic life is for Aristotle the perfect type of life. Between God, as pure form, and matter, as formless stuff,— the extreme cosmic principles, — Aristotle places the world of natural phenomena, which are all composites of the two principles. His doctrine of the Prime Mover is a direct product of his philosophy and is the first attempt to found a theistic theory on a philosophical basis. Aristotle specifies as the four causes operative in nature the formal, final, efficient, and material. But as form contains within itself the principles of efficiency, purpose, and meaning, these four causes are reducible to his dualism of form and matter. As an example of his application of the four causes, a statue presupposes: (1) matter, for example, clay, wood or marble; (2) a form or idea in the artist's mind; (3) an efficient cause, such as the energy applied to tools; (4) a motive or purpose.

Physics.— While the metaphysics treats of being as such, of the unconditioned, of the ultimate principles explanatory of reality, Physics treats of the contingent, the conditioned, and of the quantitative and qualitative relations of things. In the philosophy of nature's phenomena, the concept of motion plays the chief role, effecting the transition of potentiality to actuality and having its ultimate source in the Prime Mover. The whole of growth and development proceeds from one form of being to another form of being, but not from nothing to something, or from non-existence to existence. For Aristotle as for all the Greek philosophers the maxim holds: *ex nihilo nihil fit.* Inert matter is the most formless element in nature and man is the stage in which the highest form manifests itself. Between these nature exhibits a graded scale of development, that is, from the most inorganic to the highest organism. This scale itself is static and not a scale of evolution in the modern sense. The scale of beings is a fixed cosmic hierarchy, not determined by protoplasmic conditions plus environment. The Aristotelian world is a teleological system, the eternal forms working themselves out in plastic and contingent matter with reference to fixed final goals, the whole exhibiting plan, not planless, as Aristotle says, "like a bad tragedy." As the Prime Mover is perfect so the world shows that degree of perfection which is possible with the contingency and imperfection of matter. God is both *in* the world and *outside* of it as the transcendent cause of its order, just as the discipline of an army is in the army and outside of it in the person of the general. The universe is conceived by Aristotle to be spherical in form, not infinite. Its periphery consists of the region of the fixed stars, which revolve in a perfectly circular motion. They do not move freely in space, but are attached to the ethereal body of the outer heaven and move as a rider in a chariot. Their motion is caused immediately by the Prime Mover and being nearest to him, their motion is most perfect. The earth is at the centre of the universe and is fixed. Between the centre and the circumference are the seven planets, including the sun and moon. The motion of these, although concentric with the circumference, is less perfect, deviating from an exact circle. The earth is the region of rectilinear motion. The general presuppositions of motion are space and time. Space is, in Aristotle's conception, strictly speaking, only place, that is, it is the room occupied by body, and time is the measure of motion with reference to earlier and later. Motion being endless, time as the measure of its discrete moments is infinite. Space is finite, for there is no space outside the corporeal world. The elements in the cosmos are fire, earth, air, water, and ether. Of these the first four are sublimary. The celestial spheres consist of pure ether.

Psychology.— Aristotle defines soul as the

"complete realization of a body endowed with the capacity of life." Every body, therefore, that has life, has soul, and psychology in the narrow sense would be a branch of biology. The physical world, according to Aristotle, is divided into two realms, the inorganic and the organic. The characteristic mark of the latter is the possession of life, or "soul." Soul is synonymous with the principle of life, by virtue of which a thing is endowed with the power of self-movement. Life is the universal form of organic activity, feeling and reason are specific forms of the same power. The highest manifestation of psychical activity is rational thought. There are four main forms in which life manifests itself: (1) Nutrition, growth, decay and the power in things to reproduce, each after its kind, whereby the continuity of life is maintained; (2) locomotion; (3) sensation; (4) reason. These various types of life are forms of self-movement. The first form is found in the plant world as well as in the animal world, the last three only in the animal world. Soul as life is found in every part of the body, to which it is related as form to matter. The heart as the anatomical and physiological centre is also the life-centre. The heart, therefore, and not the brain, is the organ of consciousness, for consciousness is one of the forms of life. The processes of knowing or conscious life are developed in these stages: (1) sensation; (2) imagination, the power of using images of absent objects, combined with memory; (3) rational thought. Reason, according to Aristotle, is twofold, creative and passive. All knowledge, in the last analysis, is derived from sense-perception. The mass of sense-perceptions which are held together by memory and stored in the central sense (*sensorium*) are the passive reason, that is, they constitute the matter which the creative reason transforms into conceptual knowledge. The two stand related to each other, therefore, as form to matter, actuality to potentiality.

Ethics.— The ethics of Aristotle consists mainly in a theory of the final end of conduct or the *summum bonum* and an account of the individual virtues. The chief good is happiness (well-being), which is defined as "activity of the reason in accordance with virtue in a complete life." This conception of happiness as consisting in theoretic activity is based on the peculiar function of man. Reason being the differential mark of man, his peculiar good should be discoverable in the activity of reason. Further, the good consists in the realization of the rational self in an ethical life that is complete and not of fragmentary duration, for "one swallow does not make spring." The virtues of an individual are divided into ethical and dianoëtic. The ethical virtues are liberality, temperance, justice, courage, friendship, high-mindedness, gentleness, veracity. The dianoëtic virtues are wisdom, art, insight, cleverness, and such excellencies as attach to the theoretic activity, while the moral virtues are reasonableness expressed in action. Virtue is the power or persistent quality in an individual which enables him to perform his function well. Aristotle otherwise defines it as a "moral habit based on a life of deliberation, and expressed in the observance of a rational mean." The connecting link between ethics and politics is found in the social virtue of friendship.

Politics.— Aristotle gave to politics the position of an independent science, which he based on the study of over 150 actual constitutions. Politics, as the architectonic science, considers the complete good of man, for it is only in the state that man's full realization is attained, and man is by nature a "political animal." Ethics is, therefore, a branch of politics. Although the state is notionally prior to the household and village, it is preceded by them in the order of development. The state is such an aggregation of households and villages as to be self-sufficing. While it comes into being primarily for the sake of life, its growth is determined by the interests of a good and complete life. The individual is not self-sufficient. The end of the state is not power, nor the protection of life, property or industry, but the promotion of noble life in its citizens and of the happiness that springs from such life. The function of the state is educational and moral. One has to keep in mind that the Aristotelian state is a city-state and not an empire. The various forms of good constitutions are: royalty (rule of one), aristocracy (rule of few), polity (rule of the entire people). The corresponding corrupt forms are tyranny, oligarchy and democracy. The best constitution under most actual conditions is the polity, a constitutional democracy, which more than any form of government embodies the principle of the mean and on the average best meets the demands of the greatest number. Under completely ideal conditions monarchy is the best form of government.

Art.—Art has for its function partly the supplementing of nature and partly the imitation of nature. Nature has left man naked and defenseless, but provided him with the "tool of tools," a hand. The useful arts serve the interests of life, imitative and decorative arts serve the ends of noble pleasure and relaxation. The Aristotelian exposition of the philosophy of art is confined almost entirely to the extant fragment of the *Poetics*, in which scarcely more than the theory of tragedy has survived. The function of tragedy is described as catharsis. The conclusion of a tragic representation that is true to the principles of art has the cathartic effect on the spectator of purifying his emotions by the instruments of pity and fear.

History of Aristotelianism.— Aristotelianism was continued in the peripatetic school (the name peripatetic came from Aristotle's method of giving instruction while walking, or from the walks — περίπατοι — in the Lyceum's grounds) down to 529 A.D., when the Emperor Justinian closed all the Athenian schools. During the early Middle Ages it was kept alive by the works of Boethius and the Isagoge of Porphyry. Later by its fusion with the theology of Thomas Aquinas it became practically the offical philosophy of Roman Catholicism, which it still continues to be. The Arabs in Spain were the bearers of Aristotelianism to mediæval Europe, and by 1220 almost all of Aristotle's works had been translated from the Arabic into Latin. A little later, by the efforts of Thomas Aquinas, they were translated from Greek originals, and Aristotle's authority in science became well-nigh absolute. With the rise of Humanism Aristotelianism began to wane, and with the development of modern science and the Cartesian philosophy his influence outside the Catholic Church was to a large extent nullified. Within the

Church, however, during the last quarter of a century, through the efforts of Leo XIII., the influence of Thomism and Aristotelianism has increased.

Bibliography.—Stahr, 'Aristotelia' (2 vols., 1830–2); Grote, 'Aristotle' (2 vols., 2d ed., 1880); Grant, 'Aristotle' (1874); Lewes, 'Aristotle, a chapter from the History of Science' (1864); Siebeck, 'Aristoteles' (1899); Prantl, 'Geschichte der Logik im Abendlande' (4 vols., 1855–70); Zeller, 'Aristotle and the earlier Peripatetics' (2 vols., 1897).

William A. Hammond,
Professor of Ancient and Mediæval Philosophy, Cornell University.

Aristotle, Greek philosopher, and one of the greatest thinkers and scientific investigators and organizers the world has ever seen.

Life.—Aristotle was born in 384 and died 322 B.C. His birthplace was Stagira (hence he is often called "the Stagirite"), a city on the Thracian peninsula known as Chalcidice, which was at that time a thoroughly Hellenic country, enjoying all the advantages of Greek culture. His father, Nicomachus, was the court physician and friend of the Macedonian king Amyntas. The medical profession is said to have been hereditary in his family, and the scientific and medical atmosphere in which he grew up probably helped to form his mind in those habits of accuracy and exactness for which he is famous. Both parents having died, his education was directed by Proxenus of Atarneus. In 367 B.C., when in his 18th year, Aristotle came to Athens, and became a member of the Academy, the school of Plato (q.v.). Here he remained until the death of Plato, 20 years later. Before this time, he had become renowned for his scholarship and brilliant writings, as well as through his public lectures on rhetoric. Doubtless he had also already developed to some extent his own philosophical views. There seems to be no truth in the charges that were brought against Aristotle by later writers, that he was guilty of ingratitude and active hostility toward his teacher, Plato. As we have seen, he remained a member of the Academy until Plato's death, and in his later writings, although criticising with keen insight certain Platonic doctrines, he speaks of his master with the greatest reverence and affection (cf. Zeller, 'Aristotle and the Earlier Peripatetics,' Vol. I., Chap. I.).

After Plato's death, Aristotle resided for three years at the court of Hermias, ruler of Atarneus, who had been at one time a member of the Academy, marrying there Pythias, the niece, or, as some say, the daughter of the prince. Hermias, however, was treacherously put to death by the Persians, and Aristotle withdrew to Mitylene. Soon after (343) Aristotle was called by Philip of Macedon to undertake the education of his son Alexander, the future conqueror of the world, then a boy of 13 years. Nothing is known regarding the nature of the education which Aristotle gave to his distinguished pupil. The regular instruction of the prince must have ceased three years later when he was made regent by his father and entrusted with military duties. Aristotle remained in the north engaged in scientific work, though probably still retaining some connection with the prince and the Macedonian court. When Alexander set out upon his campaign in Asia, Aristotle went to Athens and founded there his school. Its place of meeting was the Lyceum, a gymnasium attached to the temple of the Lyceian Apollo. He was accustomed to talk to his pupils as he walked to and fro in the gardens of the Lyceum, and from this custom the school became known as the "Peripatetic" (περιπατεῖν, to walk up and down).

Here Aristotle taught and directed the various scientific activities of the school for twelve years (335–323). This school was not merely an institution for imparting instruction. It was also an intimate association of scientific workers, many of them, like Theophrastus (who succeeded Aristotle in the leadership), mature men and ripe scholars. The organization and direction of the investigations as well as the fruitful utilization of materials and synthesis of results were, however, the work of the master. During these years, Aristotle systematized the knowledge of the past, and thus defined the limits and laid the foundations of the sciences of the western nations. But he did more. He carried on investigations and extended the boundaries of knowledge in almost every field. In logic, metaphysics, ethics, and politics, he reached conclusions that are of great and permanent significance for all time. Moreover, in psychology, zoölogy, physics, astronomy, æsthetics, and also in his historical investigations, his work is of the greatest value and importance for all the subsequent developments of these sciences. See Aristotelianism.

After the death of Alexander the Great, the Greek states, with Athens at their head, attempted to free themselves from the Macedonian power. Aristotle's former relation to Alexander, and his friendship for Antipater, the Macedonian governor, made him at once an object of attack. The charge of Atheism was brought against him, as it had formerly been brought against Anaxagoras and Socrates, and he retired to Chalcis in Eubœa, where, in the following year (322), he died.

Writings.—The writings that have come down to us under the name of Aristotle do not by any means represent his complete literary activity. It is nevertheless known that the writings of Aristotle which were lost included: (1) Certain popular works published by Aristotle probably during the time of his connection with the Academy. He himself refers to these as the "exoteric," or popular writings. They were written generally in dialogue form, and modeled, both in subject matter and style, after the works of Plato. (2) Compilations of scientific, historical, and political materials, which were used by Aristotle as data in the preparation of his theoretical works. To this class belongs the 'Constitution of Athens,' fortunately discovered in nearly complete form a few years ago and published in 1891 (English translations, by F. G. Kenyon and E. Poste, both London, 1891).

The works which have survived are those which set forth Aristotle's system in more complete and systematic form, and which were used within the school. The writings which have been known to tradition as those of Aristotle, appear to have come essentially from the edition of Aristotle's works prepared and arranged

by Andronicus of Rhodes about the middle of the 1st century B.C. Of present-day editions of Aristotle's works that of the Berlin Academy (1831–70) may be mentioned. These writings may be classified in the following way:

(a) *Treatises on Logic.*— These were later collected under the title of the 'Organon.' This included the 'Categories,' 'De Interpretatione' (on the parts and kinds of propositions); the 'Analytics,' prior and posterior (consisting of two books each, and developing the doctrine of the syllogism and dealing with scientific methods in general); the 'Topics' (dealing with probable conclusions); and on 'Sophistical Elenchi' (which discusses certain fallacies and the ways of refuting them). The Bohn Library gives an English translation of these works in two volumes by O. F. Owen.

(b) *The 'Rhetoric' and the 'Poetics.'*—The former consists of three books, of which only the first two are regarded as genuine. (English translation by T. Buckley in Bohn Library.) The 'Poetics' has been preserved only in a very incomplete and fragmentary condition. An English translation is given in S. H. Butcher's 'Aristotle's Theory of Poetry and the Fine Arts' (3d ed., 1902).

(c) *The Work 'On the First Philosophy'* — our 'Metaphysics' — which Zeller describes as a torso arbitrarily bound up with a number of other fragments, some genuine, some spurious. (English translation in Bohn Library, by J. H. McMahon, 1889.)

(d) *The Works on Natural Science.*— To this class belong (1) the 'Physics,' with the connected works, 'On the Heavens,' 'On Growth and Decay,' and the 'Meteorology'; and (2) the zoological treatises, 'The History of Animals,' 'On the Parts of Animals,' 'On the Movement of Animals,' and 'On the Generation of Animals'; (3) the psychological writings, including the 'De Anima,' and the smaller treatises known as the 'Parva Naturalia.' Of these works 'The History of Animals' is translated by W. Cresswell in the Bohn Library; 'On the Parts of Animals' by J. Ogle (1882); the 'De Anima' by E. Wallace (1882), and W. A. Hammond (1902). The latter writer under the title 'Aristotle's Psychology' has given also a translation of the 'Parva Naturalia.'

(e) *The Ethics and Politics.*— Aristotle's treatise on ethics is known as the 'Nicomachean Ethics.' It has ten books, of which books V. to VII. are largely made up of additions from the 'Eudemian Ethics.' This latter work is a revision of the Aristotelian ethics by Eudemus, of which only a part has been preserved. The 'Nicomachean Ethics' has often been translated into English. Two of the most recent and best translations are those of F. H. Peters (4th ed. 1891), and J. E. C. Welldon (1892). The 'Politics,' in eight books, was left in an incomplete and fragmentary condition. (English translations by B. Jowett and J. E. C. Welldon.)

J. E. Creighton,
Professor of Philosophy, Cornell University

Aristotle's Lantern, the complex dentary apparatus or oral skeleton and associate soft parts of a sea-urchin (q.v.). The oral skeleton attains its highest development in the *Echinidea* in the Aristotle's lantern of the sea-urchins. The lantern is composed of 20 principal pieces — five teeth, five alveoli, five rotulæ, and five radii — of which the alveoli are again divided into four pieces each, and the radii into two, thus making a total of 40 pieces. This complex apparatus has, beside the inter-alveolar muscles, protractor, oblique, transverse, and retractor muscles. A somewhat similar but less complicated oral skeleton is found in the *Clypcastroida.*

Aristoxenus (Greek, Ἀριστόξενος, *Aristoxenos*), a Greek musician and philosopher of Tarentum, flourished about 350–324 B.C. He was one of the oldest writers, and probably was the greatest of Greek students of the science of music and all its branches. He was a son of Spintharus, who taught him music, having himself studied under Socrates and being possessed of a great knowledge of musical matters. After having received his elementary education he went to study music under Lamprus of Erythræ, and later became a student of philosophy under the Pythagorean Xenophilus of Chalcidice. He afterward went to Athens to study philosophy under Aristotle, and made such rapid strides that, upon the death of Aristotle, he aspired to be his successor and head of the philosophical school; Theophrastus was, however, appointed in his stead. He founded a school of musicians, who were called, after him, Aristoxeneans. The main difference between the systems of the Pythagoreans and the Aristoxeneans lay in the fact that the latter judged of the notes in the diatonic scale exclusively by the ear, while the former determined these mathematically. The only one of his works of any value now extant is a treatise on music, 'The Elements of Harmony.' It was published in three volumes by Meursius in 1616.

Arisugawa, ä're-soo-gä'wa, the title of a noble Japanese family founded in the 17th century and prominent in civil and military affairs. This ancient family was founded by the seventh son of the Mikado Go-Yozei, during his reign from 1587 to 1611. The members of the family did not, however, attain much prominence until January 1868, when Arisugawa Taruhito (b. Kioto 1835; d. 1886), who was the uncle of the mikado, was appointed supreme administrator and commander-in-chief of the army. It was at this time that the duarchy of Mikado and Shogun was abolished and the present form of government established, with the Emperor Mutsuhito as dictator with undivided power. Upon taking office he at once reorganized the army to put down the rebellion in the north, led the imperial troops against the rebels, completely routing them and saving Yeddo from destruction. After this he began military operations in the north, and by his skilful maneuvers soon brought the rebels to terms and the war to a quick conclusion. The next year, in 1869, he returned the sword of justice and the brocade banner, which he had received at the beginning of his campaign against the rebels, to the emperor, thus signifying that he had brought the empire to a state of complete subjugation. In 1875 he became president of the senate, and again in 1877 was placed in command of the forces sent to suppress the Satsuma rebellion, under the leadership of Saigo Takamori. This was a long and severe test of his military ability, and his success, though only won after seven months of hard fighting and the sacrifice of 20,000 soldiers and $50,000,000, showed him to

be a leader born of the highest order of military genius. For this great service the emperor decorated Arisugawa with the Order of the Chrysanthemum and appointed him field-marshal and junior prime minister. His brother, Arisugawa Takehito (b. 1862; d. 1895) traveled in Europe, studying the various military systems, for a time serving as midshipman on H. B. M. ship Iron Duke. Upon his return to Japan he was adopted by the emperor, as he was without heir, and immediately entered the navy as captain, serving throughout the war with China in 1894–5, and dying in the service. His portrait appeared on the first memorial postage stamps ever issued in Japan.

Arita, a-rē'ta, a Japanese town in the western part of Kyushu, famous for its pottery works, dating from the end of the 16th century. The Arita porcelain is highly esteemed.

Arithmetic. This word has been and still is used in two quite distinct senses. It formerly signified merely the science of numbers (see ARITHMETIC, HISTORY OF), and treated such numeral properties as seemed mysterious or peculiar. With the invention of algebra it was often taken to include such portions of that science as referred to the operations and to the number theory. In this sense it is still used in Germany and France to-day, the art of computation being indicated by the names *Rechnung* and *Calcul*. In English, however, the term early came to be applied to both the science of numbers and the art of computation. As the former branch developed the advanced portion was given the distinctive name of Theory of Numbers (q.v.), leaving the name Arithmetic to apply to calculation and its application to business problems. With the recent relegation of the progressions and the roots to algebra, this is the sense in which the word is used in the United States to-day. With this understanding of the term, the leading topics relating to the subject will be considered.

I. Notation and Numeration.—The former, referring to the number symbols, is from the mediæval Latin *notæ*, meaning the numeral characters (see NUMERALS), and the latter, referring to number names, is from *numerus*, number. The distinction between the terms is coming, however, to be less marked than formerly, the word numeration being used for both. The writing and reading of numbers generally refers to positive integers, common fractions (or vulgar fractions, so called to distinguish them from the *fractiones physicæ* or *astronomicæ*, the old sexagesimal fractions still met in angle measure), decimal fractions, compound numbers, and surd numbers. Of these the positive integers are known as natural numbers, the others as artificial numbers. Negative numbers, also belonging to the artificial group, have until recently been excluded from arithmetic. They have, however, so many practical applications that they are beginning to find a place, and in time they will probably be treated in arithmetic so far as necessary for cases involving numbers of opposite nature, like debt and credit, opposed forces, and contrary directions.

The distinctive feature of our present numeral system (see NUMERALS) is its place value. The characters for 5 and 1, written in juxtaposition, indicate addition in the Roman system (VI.); but in the Arab-Hindu notation (51) they indicate 5 *tens* and 1 unit, the 5 having a place value showing that it represents tens. Thus by means of only 10 characters we are able to write numbers of any desired magnitude, and by means of the simple device of decimal fractions we are also able to represent any numbers, however small.

II. Scales.—Because man has a natural counting apparatus in his 10 fingers (see FINGER NOTATION) the world has come to write numbers on a scale of 10, and to give them names based upon a decimal system. We might use other scales, and the duodecimal (scale of 12) would be better on several accounts, although a change is not practicable. There has always been some tendency to use the scale of 12, as is seen in such tables as 12 in. = 1 ft., 12 oz. = 1 lb. troy. The superiority of the duodecimal over the decimal scale lies in the fact that 12 has more exact divisors than 10 has. Therefore the fractions most commonly employed could better be represented on the scale of 12, as is here shown:

	Scale of 10	Scale of 12
½	0.5	0.6
⅓	0.333...	0.4
⅔	0.666...	0.8
¼	0.25	0.3
¾	0.75	0.9
⅛	0.125	0.16
$^1/_{12}$	0.08333...	0.1

In the tables of denominate numbers the tendency formerly was to adopt a varying scale, but at present it is entirely toward a uniform scale, as in the metric system (q.v.):

Uniform scale	Varying scale
10 mills=1 cent	2 pints=1 quart
10 cents=1 dime	8 quarts=1 peck
10 dimes=1 dollar	4 pecks=1 bushel

III. The Fundamental Operations.—These are now commonly considered as four in number, although formerly as many as nine *species*, *atti*, or *passioni*, as they were called, were given. They sometimes included doubling (*duplatio*), because a common method of multiplication was by successive duplations. They also included halving (*mediatio*), this operation being often used in effecting a division. The Rule of Three, Evolution, and Progressions were also commonly included. The fundamental operations may more scientifically be classified as follows, each direct process having two inverses:

Direct	Inverse
Addition: $2+3=5$.	Subtraction: $5-2=3$, $5-3=2$.
Multiplication: $2\times\$3=\$6$.	Division: $\$6\div2=\$3$. $\$6\div\$3=2$.
Involution: $2^3=8$.	Evolution: $2=\sqrt[3]{8}$. Logarithms: $3=\log_2 8$.

Of these the primitive one is addition, multiplication by a positive integer arising when the addends are equal, and involution to a positive integral power arising from multiplication when the factors are equal. Arbitrarily, elementary arithmetic has usually excluded evolution beyond the cube root, and logarithms. It is now tending to relegate cube root to algebra on account of its difficulty and lack of applications. The exclusion of logarithms (q.v.) is due to their relatively late invention, since, if the theory of their computation is ex-

cluded, the subject is simple of presentation and valuable in application.

From the primary operations with natural numbers have been derived operations, designated by the same names and subject to the same laws, involving the artificial numbers. For example, $2 \times \$3 = \$6$ means that \$3 is taken 2 times as an addend, thus: $\$3 + \$3$. But $\frac{2}{3} \times \frac{6}{7}$ cannot mean that $\frac{6}{7}$ is taken as an addend $\frac{2}{3}$ of a time. It means that $\frac{2}{3}$ of $\frac{6}{7}$ is taken, or that $\frac{1}{3}$ of $\frac{6}{7}$ is taken 2 times. It is, however, convenient to broaden the definitions so as to use the same phraseology and symbols as in the case of positive integers. Similar considerations fix a meaning for $-2 \times -3 = +6$, $\sqrt{2} \times \sqrt{3} = \sqrt{6}$, and $\sqrt{-2} \times \sqrt{-3} = -\sqrt{6}$. In certain cases an operation is so difficult that it is more convenient to substitute for it another which gives the same result. This is seen in the case of the division of fractions, where to divide $\frac{2}{9}$ by $\frac{3}{7}$ it is easier to multiply $\frac{2}{9}$ by $\frac{7}{3}$ than to reduce to a common denominator as was formerly done, and then divide, thus: $\frac{2}{9} \div \frac{7}{3} = \frac{2}{9} \div \frac{21}{9} = \frac{2}{21}$.

Of the four common operations, addition is the simplest of comprehension, although not in actual work. In fractions it is usually easier to multiply than to add, as in the case of $\frac{3}{7} \times \frac{14}{27}$ compared with $\frac{3}{7} + \frac{14}{27}$. With integers, both addition and multiplication require the learning of 45 combinations of numbers $(1 + 2,\ 1 + 3,\ \ldots\ 1 \times 2,\ 1 \times 3\ \ldots)$, and the mere memorizing of these facts is as easy in one operation as the other. Subtraction does not require memorizing a table, since it is merely the inverse of addition, and if taught by the "making change" method it uses the addition table, as division uses that of multiplication.

IV. Checks.—An important consideration in all computations is the checking of the work, to be reasonably sure that no error enters. Checks should be applied at every opportunity so that an error may be discovered as soon as it is made, and not vitiate the further work. The most important check in addition is the repeating of the work in the opposite direction, adding downwards if the first addition was upwards. The psychological reason for this is that like stimuli tend to produce like reactions, and if an error has been made it is liable to be made again if the numbers are soon met in the same order. Hence the order is reversed to counteract this tendency. In subtraction the best check is that of adding the subtrahend and remainder. If the remainder was obtained by the "Austrian" or "making change" method, this addition should be performed in the opposite direction as in the check for addition. The best check for multiplication and division is that of "casting out nines." This ancient Oriental method was of especial value when the sandboard form of the abacus (q.v.) was used, since the numbers were so frequently erased as to render a general review of the work impossible. This check has gone out of use in American schools, but it is so simple and valuable that it will probably be revived. The check depends upon two propositions: (1) The excess of 9's in a number (that is, the remainder arising from dividing a number by 9) is the same as the excess in the sum of the digits. In the case of 1247 the sum of the digits is 14, and this divided by 9 gives a remainder of 5. It is customary to cast out the 9's as the digits are added, thus: $7 + 4 = 11$; cast out 9 and 2 is left; $2 + 2 + 1 = 5$, the excess. (2) The excess of 9's in the product equals the excess in the product of the excesses of the factors. In the case here given, the excesses in the factors are 5 and 3, indicated in the right and left angles of the cross. The excess in their product (15) is 6, indicated in the upper angle. The excess in the product, 26187 is 6, indicated in the lower angle. The upper and lower numbers in the cross are the same, showing that the result is probably correct.

$$
\begin{array}{r}
1247 \\
\underline{21} \\
1247 \\
\underline{2494} \\
26187
\end{array}
\qquad
\begin{array}{ccc}
 & 6 & \\
3 & \times & 5 \\
 & 6 &
\end{array}
$$

In division, the excess of 9's in the dividend equals the excess in the product of the excesses of the divisor and the quotient, plus that in the remainder. Of course, the check of 9's fails to detect an error involving a multiple of 9. There is a somewhat similar check by casting out 11's, requiring slightly longer time, but in some respects more liable to detect errors.

V. Short Processes.—There are numerous short processes of performing operations, or rather of securing results by substituting simpler operations than those to be performed. Thus to multiply by $12\frac{1}{2}$ it is often easier to annex two zeros (or move the decimal point two places to the right) and divide by 8. In the same way it is easier to multiply by 100 and divide by 4 than to multiply by 25. Such processes depend upon simple number relations of the following kind: $12\frac{1}{2} = \frac{100}{8}$, $25 = \frac{100}{4}$, $33\frac{1}{3} = \frac{100}{3}$, $125 = \frac{1000}{8}$, $75\% = \frac{3}{4}$, $125\% = 1\frac{1}{4}$, $66\frac{2}{3}\% = \frac{2}{3}$. The publication of extensive tables and the perfecting of calculating machines (q.v.) have rendered obsolete most of the short processes involving other kinds of multipliers and divisors.

VI. Compound Numbers.—The four fundamental processes with compound numbers were formerly considered of much importance, since before the introduction of decimal fractions most tables of denominate numbers were on a varying scale. Within a century, however, the metric system (q.v.) and various monetary tables have so decimalized denominate numbers as to take from compound numbers most of their former importance. The only case in which several denominations are commonly used in writing a number to-day is that of English money. In most countries the whole subject is obsolete. The United States still uses the British system except in the monetary table, but it has greatly simplified it, rarely using more than two denominations in the same number. Indeed, within a single generation the metric system has come to be used exclusively in this country in scientific laboratories, and the efforts now being made to secure a large foreign trade will make the system more and more known in commercial and industrial affairs.

VII. Methods of Solving Problems.—There are five general methods of attacking an applied problem, as follows:

(1) We may study typical problems and thus acquire the habit of solving others of the same nature. This is the oldest method, and was practically the only one in use before the 17th century. At present it is coming into renewed prominence in American schools, the type problem being attended (as was not formerly the case) by a large number of exercises.

(2) We may commit to memory rules for

all general classes of problems liable to be met. Historically, this is the second method of attack, and it characterizes the American text-books until nearly the close of the 19th century. The rules were usually inductively inferred from type problems, and pupils committed them to memory. Since in practical life we never depend upon a verbatim rule, this method is rapidly becoming obsolete. In mediæval times there was much effort expended in searching for a general rule that would solve all arithmetical problems. Hence arose the Rule of Three (see ARITHMETIC, HISTORY OF), the Rule of False Position, and other rules of less importance, all of which lost their chief value when algebraic symbolism was invented. Of these general rules only the Rule of Three has survived, being now recognized in the form of Proportion.

(3) We may learn formulas instead of rules. This method was received with some favor for a time, but it has been discarded as a general plan. It has all of the defects of the method of rules, with the added difficulty of an unnecessarily confusing algebraic symbolism.

(4) We may analyze each problem as it arises, simply applying common sense to the solution. When problems are, as they always should be, properly graded to the understanding of the pupils, this plan is better than any of the preceding ones. It establishes a habit of independence and of confidence that is wholly wanting in the older methods.

(5) We may bring to the aid of analysis the representation of the unknown quantity by the familiar algebraic symbol x. This materially simplifies the analysis, and most writers on arithmetic at the present time advocate the plan. The concept of the linear equation with one unknown is a very simple one, and it greatly clarifies the analysis in many cases.

VIII. Nature of the Problems in Arithmetic.—The interests of the ancient and mediæval philosophers were not at all commercial. These men were attracted rather by considerations of the properties of numbers and by puzzles which were imagined to sharpen the wit. The rise of commerce in the later Middle Ages and at the time of the Renaissance, brought into the science a large number of applied problems representing actual business conditions. Principles of conservatism have tended to keep these ancient problems from generation to generation, strengthened by the feeling that mental discipline was as well secured from an obsolete as from a modern problem. It is therefore only recently that the question has arisen, What should be the nature of the problems set for children studying arithmetic? In answer to this question teachers seem to be tending to observe the following principles:

(1) A problem that pretends to set forth a business custom should state the real business conditions of the present. This excludes obsolete business problems, it being the opinion that better mental discipline can be secured from a question relating to genuine commercial matters of the present, than from one relating solely to forgotten customs.

(2) Problems should appeal to the interests and understanding of the children in their respective school years. Arithmetic was formerly taught only to boys who could read and write and who were preparing for business. When the subject found its way into the earlier school years it carried many difficult problems of business down to immature minds. The modern tendency is to replace such problems by others that relate to children's interests. Thus in the primary grades there should be the study of home purchases, of the application of number to the large interests of the country, especially such as appeal to a child's love of nature and of the heroic, and such as relate to the sources of food and clothing. Later, the problems should refer to the more detailed features of the national and world life, to the great industries, trades, and transportation facilities. Finally they should relate to the details of the industrial and commercial life, thus preparing both the boy and the girl for earning a livelihood. In all this there should be an effort to make arithmetic interesting, since when the interest of the pupil is secured the work is prosecuted with more zeal and is attended with better and more permanent results.

(3) In the effort to modernize the problems care must be taken to avoid the extreme of withdrawing from arithmetic all topics involving effort, thus making the subject insipid from its very lack of fibre.

IX. Sequence of Topics.—Formerly arithmetic was taught from a single book, each important topic being met but once. Then came the two-book series, the second book covering the ground of the first, but with more difficult examples, thus forming a spiral of two revolutions. In this way there arose the so-called Spiral Method of treatment, which certain devotees have carried to the extreme of returning to each topic every few days. Between the older topical method and the radical spiral method there has been considerable strife. The latter asserted that the former encouraged forgetfulness because of a lack of review, while the former asserted that the latter gave the pupil no feeling of mastery of any subject. The result has been a compromise, as is seen in all modern American courses. Such important topics as percentage are treated several times, with progressive difficulty, applications like simple interest offering new features on each succeeding occasion. On the other hand, such relatively unimportant chapters as that on longitude and time (semigeographical) are met but once. In the same spirit, the fundamental operations with integers, decimal fractions, and those common fractions often met in business, are frequently reviewed, while compound numbers and fractions involving unusual numerators and denominators are less emphasized. The technicalities of business, including the study of investments, insurance, banking, and exchange, are reserved until the last years of the grammar school, when a child beginning to look forward to being self-supporting is prepared to understand them.

X. Methods.—Various methods have been suggested for presenting arithmetic to children, especially in the primary grades. The serious consideration of this phase of the subject began towards the close of the 18th century, particularly in Germany and Switzerland. With it are connected such names as Trapp, von Busse, Kranckes, Pestalozzi, Tillich, Grube, Tanck, Knilling, and Kaselitz. Each of these writers stood for some principle which he carried to

such an extreme as to render the method generally unusable. Pestalozzi, for example, did great good in his judicious use of objective illustration, but he went to an unwarranted extreme in his emphasis of the unit and in his devotion to abstract work. Tillich suggested a valuable set of number blocks, but his followers went to the extreme of eliminating all other material. Grube wrote a condensed manual for teachers, and systematically treated numbers in concentric circles of progressive difficulty, but he went to several extremes that made the system so absurd that it is now nearly forgotten. On the other hand, every prominent writer of this class has usually suggested some slight improvement which has gradually worked its way into the schools. It has been the universal experience that no advocate of a single method has been able to impress this method on any considerable number of followers. The best teacher has been the one who, being interested in the subject, has imparted that interest to the pupils, who has not been limited to any one set of objects or to any peculiar device, who has made arithmetic modern in its applications, and who has followed the best curricula of the day.

XI. Time Required for the Subject in the Schools.—There has been a gradual diminution in the time allowed to arithmetic in American schools for a number of years past, on account of the demands of more modern studies for a place in the curriculum. As a result there has been decreased attention to the subject, there is less ability on the part of pupils to grapple with problems, and the question has arisen as to the amount of time necessary to secure a reasonable facility in the arithmetical processes. Although the text-books and the teaching have both improved, the curtailment of time and the scattering of the pupils' attention over more subjects have left the results far from satisfactory. It has even been urged that arithmetic be not taught before the third nor after the seventh school year, thus allowing five instead of eight years to the subject. But although it is true that the necessary parts of arithmetic can be covered in five school years, it is equally true that the child has as much delight in his work with numbers in his first school year as he has in the other subjects studied, and quite as much need for this work. It is also true that the number facts are more easily impressed on the memory if the work is begun, as Pestalozzi advised, when a child first enters school. It is therefore better to allow arithmetic to extend throughout the elementary grades, combining with it, if the class is well advanced, some constructive geometry and the first steps in algebra in the eighth school year.

Bibliography.—Smith, 'The Teaching of Elementary Mathematics' (New York 1900); 'The Outlook for Arithmetic in America' (Boston 1904); Brooks, 'The Philosophy of Arithmetic' (Philadelphia, 2d ed., 1901); Unger, 'Die Methodik der praktischen Arithmetik' (Leipsic 1888).

DAVID EUGENE SMITH,
Professor of Mathematics, Teachers College, Columbia University, New York.

Arithmetic, History of. Among the ancients there were two distinct sciences now called by the name arithmetic. One had to do with the science of numbers and the other with the art of computation. The former was called, by the Greeks, *arithmetic* (ἀριθμετική), and the latter *logistic* (λογιστική). Logistic was taught to boys going into trade, and among the most ancient peoples it probably involved the use of the abacus (q.v.) and commercial rules relating to rents, loans, exchange, and the settlement of accounts. The nature of the problems being simple, and abacus computation depending largely upon manual training, the instruction in this art seems to have been entirely oral. On this account no ancient work upon the subject is extant, and our knowledge concerning it is derived from such sources as the Babylonian cylinders, early Cretan remains, certain fragments of Egyptian papyri, and the occasional references of literary writers. In the Middle Ages the instruction offered by the Church schools was so meagre from the commercial standpoint that arithmetic schools (*Rechenschulen*) were established, and in these logistic (*Rechnung*) was taught. A number of manuscripts of the 13th, 14th, and 15th centuries are extant showing the nature of the problems then considered necessary, but extant treatises on counter reckoning (see ABACUS) are mostly confined to the first century of printing. Not a few of the problems of importance at that time still survive in the arithmetics of to-day, although substantially obsolete from the commercial standpoint.

The Greek *arithmetic*, or theory of numbers, begins with Pythagoras (q.v.), about 530 B.C., who taught their mystic properties, and to whose school is probably due most of their ancient classification. The fundamental division of numbers seems to have been into odd (ἄρτιοι) and even (περιττοί), the former being masculine, divine, lucky, and the latter feminine, earthly, unlucky. The expression "There is luck in odd numbers," appears in Vergil as "*Numero Deus impare gaudet,*" and probably goes back to the Pythagoreans. The odd numbers were, on account of their geometric representations, also called gnomons (γνώμονες), and it was well known that the sum of the first n of these gnomons, including 1 (which was not generally considered a number until the 17th century), was a square (τετράγωνος). The side (πλευρά) of the square was called by the later writers *radix* (*root*, whence *radical*). It is therefore evident that the Greeks looked upon arithmetic from the standpoint of geometry. Following out this plan, they studied triangular numbers, formed by arranging dots in the form of a triangle, as in the case of 3 (∴), 6, 10, etc., and also pentagonal and other *figurate numbers*, solid as well as plane. Many other classifications were suggested by the Greeks, some of which have remained in our school books until quite recently. Such, for example, included *perfect numbers* (τέλειοι), which are equal to the sum of all possible factors, including 1 (for example, $28 = 1 + 2 + 4 + 7 + 14$), and *amicable numbers* (φίλιοι), each of which equals the sum of the possible factors of the other, including 1 (for example, 220 and 284). Euclid (q.v.) (c. 300 B.C.) emphasized the ancient arithmetic in his books II., V., VII., VIII., IX. and X., although II., V., and X. are nominally geometric. Soon after, Eratosthenes (q.v.) (c. 225 B.C.) made a particular study of primes, and

invented a "sieve" (κόσκινον), which bears his name, for the purpose of sifting out the composite numbers. In the next century Hypsicles (c. 180 B.C.) made a more extensive study of progressions than had before been attempted. It is, however, to Nicomachus (q.v.) (c. 100 A.D.) that we owe the first great treatise on arithmetic (Εἰσαγωγὴ ἀριθμητική), a work which sought to do for that subject what Euclid had done for geometry, and which actually succeeded in turning the attention of the later Greeks from the science of form to the science of number. The next great arithmetician was Diophantus (q.v.), who wrote probably in the 4th century. His arithmetic (Ἀριθμητικά) professes to be in 13 books, but only six (seven in one Vatican MS.) are extant. In the main, however, this treatise relates rather to algebra.

The greatest difficulty of the ancient arithmeticians and calculators lay in the treatment of fractions. This is seen in the oldest mathematical treatise of any note as yet deciphered, a papyrus copied by one Ahmes, an Egyptian scribe of c. 1700 B.C., from an earlier MS., probably dating from c. 2300 B.C. Here all of the fractions, save $\frac{2}{3}$, have 1 as a numerator. For example, $\frac{2}{17}$ was written, in hieratic characters, as $\frac{1}{12}\ \frac{1}{51}\ \frac{1}{68}$, this meaning that the sum of these unit fractions equals $\frac{2}{17}$. The Akhmim papyrus, written more than 3,000 years after the original of the Ahmes work, gives the same treatment of fractions, thus testifying to the difficulty of the subject. While the Greeks and Romans simplified the subject and improved the symbolism, it is to the Hindus and Arabs that we are indebted for our present convenient forms.

The Romans contributed but little to the theory of numbers, although their mercantile spirit doubtless led them to improve the abacus. Their only writer of prominence was Boethius (q.v.), who, early in the 6th century, did much to make the ideas of Nicomachus known in western Europe, and whose treatise was the standard in the Church schools for many centuries.

Of the early Hindu arithmeticians but little is known. There are, however, several works extant that set forth the theory and practice of numbers in the period following the introduction of the zero and the consequent perfecting of the system of place value. (See NUMERALS.) It is in this period that the foundations for our common arithmetical operations were laid. From the Hindus the Arabs of the Bagdad school (c. 800 A.D.) drew their inspiration. The earliest Arab writer to make extensive use of the Hindu numerals, in a text-book on arithmetic, was Al Khowarazmi (q.v.). So prominent was his treatise that his name became a synonym for the Hindu arithmetic, even as Euclid became synonymous with geometry. The early Latin translations, one of which was made by Adelard of Bath (q.v.) (c. 1120 A.D.), went by such names as 'Liber Algoritmi' ('The Book of Al Khowarazmi'), whence comes our word *algorism* (*algorithm*, in Chaucer *augrim*), a name for a long time used to mean the arithmetic of the Hindu numerals.

The Arab arithmetic became known in Christian Europe chiefly through the 'Liber abaci' of Leonardo Fibonacci of Pisa (q.v.), in 1202. In the 13th century the great revival of trade brought into prominence the commercial aspect of the subject, and from this time on the theoretical treatment as exemplified in the works of Nicomachus and Boethius gradually lost ground.

The first printed arithmetic appeared anonymously at Treviso, in Italy, in 1478. In Germany the first one to appear from the press was published at Bamberg in 1482. The commercial supremacy of Italy and Germany was such that their works for the next century were largely mercantile, the arithmetics of the Boethian type being published more often in Paris than elsewhere. It was quite late in the 16th century before France produced many commercial arithmetics, and when these did appear the tendency to unite some of the features of the Boethian arithmetic gave their books considerable influence. The first arithmetic to be printed in England was the prolix theoretical work of Bishop Tonstall (1522), and it was not until about the middle of the century that Recorde (q.v.) began to publish his popular commercial text-book. Owing to the great mercantile activity of Holland between 1575 and 1650, a large number of arithmetics appeared in that country early in the 17th century, and materially influenced the text-books of England. To this creative period of arithmetic is due a large amount of matter once of importance but now quite obsolete. An extended treatment of compound numbers and of certain forms of exchange was more necessary then than now; barter was of great importance; partnership accounts were settled by a process quite different from that of to-day; alligation was of real use in the numerous mints then existing; proportion (usually in the form of the Rule of Three, *Regula de tre*, *Regeldetri*) was much more often used in practice than at present. The first arithmetic to be printed in America was Hodder's popular English work, which was republished in Boston in 1719.

The symbolism of arithmetic amounted to very little before the 19th century, when the symbols invented for algebra (q.v.) between 1550 and 1650 were rather injudiciously adopted in elementary arithmetic. The greatest advance since 1600 has been the invention of decimal fractions, a feature which revolutionized business arithmetic, making percentage simple and common, and rendering tables practicable.

The operations of arithmetic were formerly performed on some kind of abacus (q.v.). At the time of the invention of printing our present forms of addition and subtraction were quite common. There were, however, several methods of multiplication, although our present form was already in favor. The present method of division did not come into general use until the 17th century, although it appears in rare cases in the 15th.

Bibliography.—Unger, 'Die Methodik der praktischen Arithmetik' (Leipsic 1888); Cantor, 'Vorlesungen über Geschichte der Mathematik' (Leipsic 1880–1900, 3 vols., various editions); Sterner, 'Geschichte der Rechenkunst' (Munich 1891); Fink, 'History of Mathematics' (trans. by Beman and Smith; Chicago 1900); Peacock, article on "Arithmetic" in the 'Encyclopædia Metropolitana.'

DAVID EUGENE SMITH,
Professor of Mathematics, Teachers College, Columbia University, New York.

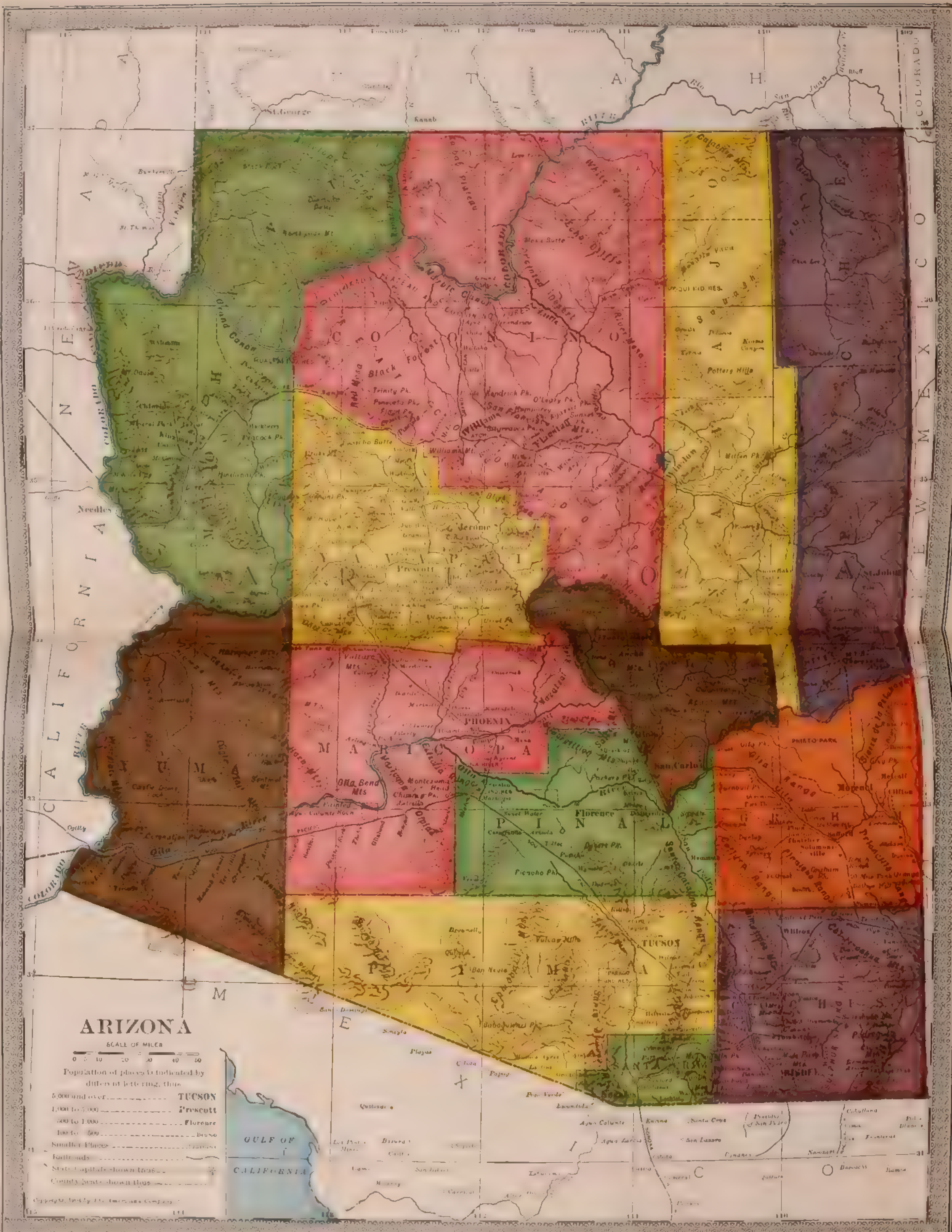
Arizona (from the former Papago locality of *Arizonac*, or *Arizonaca*, probably meaning "place of small springs," a few miles from the present Nogales, where some celebrated nuggets of silver were discovered in 1736–41. It has no connection with "arid zone," etc.). A Territory of the United States (Western or Pacific group), bounded by Utah and Nevada on the north, New Mexico on the east, Mexico on the south, Nevada, California, and Lower California on the west. It extends from lat. 31° 20′ to 37° N. and from long. 109° 2′ to 114° 35′ W. Area, 113,020 sq. mi. (72,332,800 acres), thus ranking sixth in size among the States and Territories. (See TERRITORIES.)

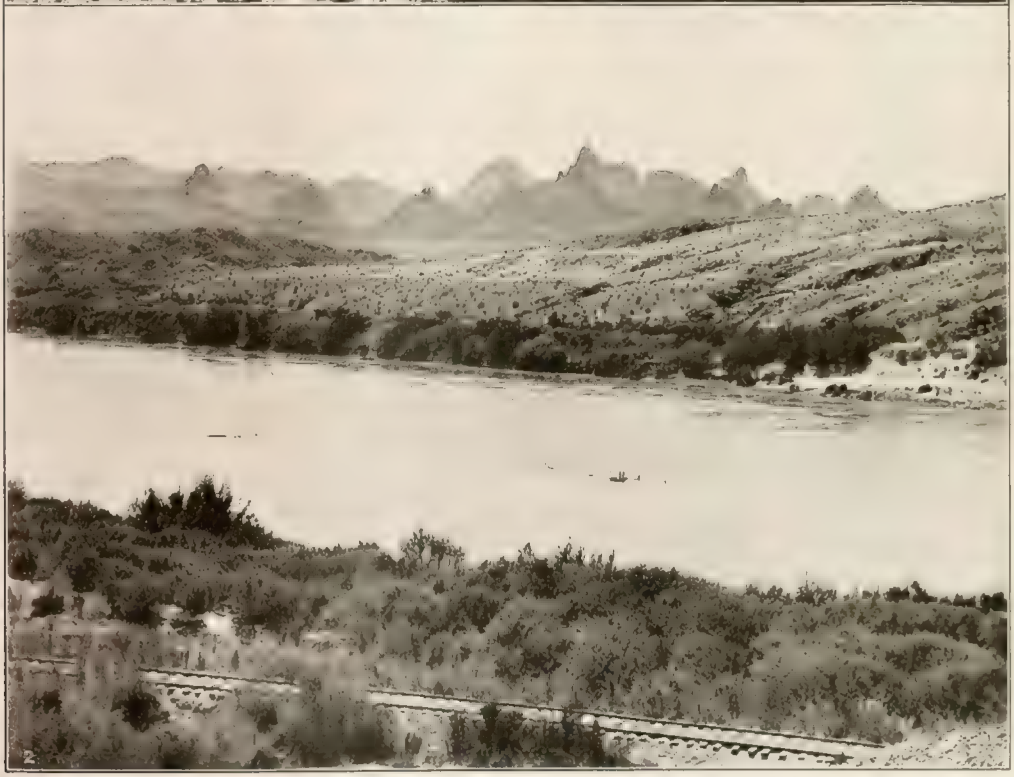
Topography and Geology.— Topographically the Territory presents two great divisions: a plateau region in the north, made up of approximately horizontal strata, and the mountainous region in the south, consisting of uplifted strata plicated and folded with minerals rocks and intrusive veins. These mountain ranges are numerous and have a general northwest and southeast trend, with intermediate broad valleys often 20 to 30 miles wide. The chief mountain masses are the Castle Dome, Big Horn, Eagletail, Chocolate, Dome Rock, Palomas, Harquahala and Harcuvar in the southwest; the Aquarius and Colorado in the west; the great plateaus rising in what are sometimes called the Northside mountains in the northwest; the San Francisco and Black in the north central; the Carrizo, Lukachukai, and Tunicha in the northeast; the Zuñi, White, Mogollon, and Apache in the east; the Gila, Peloncillo, Pinaleño, Dragoon, Galiuro, Santa Catalina, Huachuca, and Baboquivari in the southeast and south. The isolated volcanic San Francisco mountain, above Flagstaff, is the highest of all, rising in its greatest height to 12,794 feet, and in Humphrey peak to 12,562 feet. The other important peaks in the Territory are Thomas, 11,496 feet; Escudillo, 10,691; Graham, 10,516; Ord, 10,266; and Greens, 10,115, while many others exceed 5,000 feet. To the south the surface falls sharply to low ridges, mostly volcanic; thence by terraced mesas to a great desert plain little above sea-level, cut by gullied stream-beds drawing the occasional rainfall to the broad and shallow Gila. The great northern plateau, or series of plateaus, range in altitude from 5,000 to 7,500 feet; rising from them are numerous mountain spurs, buttes, and the cones of extinct volcanoes, while the Colorado river has cut through 6,000 feet of strata, exposing formations down to Carboniferous and Tertiary marine strata, underlying Tertiary lake sediments and later alluvium; indeed it has been said that every period of the world's history since the dawn of life is represented in the geology of Arizona. The surface of the land as it lies was formed by a huge Eocene uplift, the water action afterward cutting the gorges and shaping the mesas and buttes; another took place in the Miocene, with eruptive volcanoes. Near Holbrook, Navajo County, is a wonderful chalcedony forest (see FOREST, PETRIFIED), with trunks four feet thick cracked into exquisitely colored blocks. Everywhere a feature of the landscape in the northern section are the great isolated mesas of sandstone with scarped and pinnacled sides, often more than a thousand feet in sheer height. Most of the stream courses are dry save in the rainy season, and even then their flow is sometimes swallowed by the sands. The one considerable river is the Colorado (q.v.) which flows generally southwest from Utah for 400 miles through the famous Grand Cañon of Arizona (q.v.), one of the wonders of the world, then turning south, forming the western boundary of the Territory until shortly before it reaches the Gulf of California. Its chief affluent in the Territory is the Gila, which flows entirely across its southern portion; other tributaries are the Virgin, which crosses the extreme northwest corner; the Colorado Chiquito or Little Colorado in the north, and Bill Williams fork in the west. Important tributaries of the Gila are the Salado, or Salt, and the Verde from the north, and the San Pedro from the south.

Climate.—Arizona is entirely within the arid region, but owing to the difference in altitude of the northern and southern portions there is a wide range in temperature, as likewise in precipation between the two sections. The average annual precipitation at Flagstaff from 1859 to 1902 was 24.65 inches, that of Yuma 2.84 inches; while the mean temperature is 45° in the north and 69° in the south. The sandy plains of the southwestern part are the hottest region north of the Isthmus of Panama, 120° in the shade being frequent in summer; but even in this lower area, owing to the dryness of the atmosphere, the heat is not very oppressive in summer, while the winter climate is usually delightful. Heavy snows occur in the mountainous country of the north, and sharp frosts are frequent even in the Salado and Gila valleys; but nowhere are the mountains perpetually snow-capped. In recent years Arizona has become a popular resort for those suffering from pulmonary tuberculosis and catarrhal ailments.

Minerals and Mines.— Arizona is rich in minerals and its mining industry is of prime importance. In 1901 it was third among the States and Territories in copper production, 130,778,611 lbs. having been mined; it was also fifth in silver (2,812,400 fine ozs., commercial value $1,687,440), and sixth in gold (197,515 fine ozs., commercial value $4,083,000). Of lead 4,045 short tons were mined, and the industry is steadily increasing. The value of clay products was $92,986. There are also deposits of coal (as yet but little worked), fluorspar, mica, molybdenum, nickel ores, limestone, marble, granite, sandstone in limitless quantities, chalcedony, tungsten, turquoise, vanadium, garnet (pyrope), and other minerals, and there are numerous hot and mineral springs.

Soil, Agriculture, Forestry.—Of the 72,332,800 acres in the Territory, only 5,200,000 acres are privately owned (the remainder being either public or reservation lands), and of this area only 254,521 acres are actually cultivated. The valley lands, however, are marvelously fertile, experiment demonstrating that in the southern part, under favorable conditions, the yield per acre is 2,150 lbs. for wheat, 4,000 to 5,000 lbs. for potatoes, 12,300 lbs. for tomatoes, 5,000 lbs. for strawberries, 27,000 lbs. for melons, and 1,735 lbs. for corn. Lack of water has been more or less a hindrance to the development of


ARIZONA
SCALE OF MILES
Population of places is indicated by difference in lettering, thus
5,000 and over TUCSON
1,000 to 5,000 Prescott
500 to 1,000 Florence
100 to 500 Benson
Smaller Places
Railroads
State Capitals shown thus
County Seats shown thus
GULF OF CALIFORNIA
PHOENIX
TUCSON
Prescott
Florence
Needles
Kanab
St. George



1. The San Francisco Mountains. 2. The Needles.

the agricultural sections, but with the construction of storage reservoirs, recently undertaken by the Government, it is estimated that a total of 10,000,000 acres, or 40 times the present area under cultivation, will be reclaimed. The staple crops are alfalfa, barley, wheat, sorghum, kaffir corn, root crops, sugar beets, green vegetables and small fruits of every variety, apricots, grapes, oranges, lemons, figs, almonds, olives, etc. Experiments in the cultivation of Egyptian cotton are also being made, and it is expected that vast tracts of alkali lands in the south, hitherto believed to be waste, can be utilized for date-culture. In 1899 honey and wax valued at $67,489 were produced.

The mountains and mesas of the northern part are generally covered with nutritious grasses, forming excellent pasturage for cattle and sheep, while irrigated pastures in the south afford means of fattening for market. In 1900 there were 742,635 neat cattle, 924,761 sheep, and 125,063 horses. In 1903 there were slaughtered, for home consumption, 41,803 cattle, while 78,846 were exported. In the same year 250,000 sheep (valued at $2.50 each) were sold. The wool clip aggregated 3,500,000 lbs., valued at 13c. Ostrich farming has become a profitable industry; there are about 1,000 birds, some of which yield a pound of feathers every eight months, the maximum market value being $125 per pound.

The southern plains and parts of the north have a dress of sagebrush, greasewood, yucca, cactus, and other desert growths. Cottonwoods line almost every stream. Mesquite, the giant cactus or saguaro, paloverde, ironwood, Jerusalem thorn, and other trees are indigenous to the southern plains, and vast mountain areas throughout the Territory are covered with pine, cedar, juniper, and other valuable timber. An important lumbering industry has been developed in the vicinity of the San Francisco mountains, but vast tracts of timber in this and other sections have been set aside by the Government at the San Francisco, Black Mesa, Prescott, Santa Rita, Santa Catalina, Mount Graham, Chiricahua, and Grand Cañon forest reserves.

Manufactures and Commerce.—These are both in their infancy, the chief manufactures consisting of smelting and mining ($17,286,517 in 1899), lumber, etc., and carshop work. The value of imports (port of Nogales) in 1903 was $8,469,899; of exports, $4,534,388, a large part being free of duty. Duty collected, $123,805. Internal revenue collected, $45,052.

Railroads, Post-Offices, Periodicals.— In 1903 there were 1,766 miles of steam road, against 1,094 in 1890 and 349 in 1880. The principal lines are the Santa Fé Pacific (393 mi.) across the northern and the Southern Pacific (383 mi.) across the southern portion. At the close of 1903 there were 248 post-offices and 53 periodicals (16 daily, 35 weekly, and 2 monthly).

Finances.—Assessed valuation in 1903, $43,-088,004 (distributed by counties as below); in 1897, $30,613,703. Public debt, net, $1,064,593. Average tax, $1.05 per $100. In the same year there were 11 national banks (capital, $602,500; surplus, $257,631; outstanding circulation, $292,-600; deposits, $3,730,784), and 22 Territorial banks (capital, $773,310; surplus, $301,195; deposits, $4,750,569). There are six building associations with loans of $731,817 on real estate.

Education.— The Territory has a good public school system and is energetic in extending its facilities to its children despite the scattered population. Education is compulsory. The school population in 1903 (6–21 years) was 25,951; enrollment, 20,008; daily attendance, 47 per cent. School libraries contain 15,366 volumes; value of buildings and furniture, $727,-182; teachers employed, 115 men (average salary, $80.33), 359 women (average salary, $67.53). In teachers' salaries Arizona is exceeded only by California and Nevada. Cost of maintenance, 1885, $138,164; in 1903, $415,243. There is a Territorial university at Tucson, normal schools at Tempe and Flagstaff, and high schools at Phoenix, Prescott, and Mesa. There are also numerous private schools and 22 sectarian schools (see below). The Government maintains boarding and day schools for Indians among the various tribes, as well as at Phoenix, Tucson, and Rice Station. These had a total enrollment of 3,195, with 488 teachers and other employes, the cost exceeding $286,000 in 1901.

Religions.— Owing to the large number of persons of Spanish descent and to the activity of the early Jesuit and Franciscan missionaries, the population is largely Roman Catholic. Following are the statistics:

Denomination	Churches	Ministers	Members	Sunday schools	Other schools	Property
Catholic	31*	23	27,000	26	15	$249,400
Mormon	34	146†	6,264	44	4	111,724
Methodist	21	21	1,170	27	....	128,000
Presbyterian	23‡	20	2,112	25	3	126,000
Episcopalian	5	10	1,680	9	....	....
Methodist (Southern)	11	10	757	13	....	42,200
Lutheran**	....	2	58	3	....	[illegible]
Disciples of Christ	5	2	300	4	....	8,000
Others	13	18	567	14	....	15,550

* Including cathedral at Tucson. There is also an academy, hospital, and sanitarium at Tucson.
† Returns incomplete.
‡ Also five missions.
** Among Apache Indians only.

Charitable, Penal.— The Territory maintains an asylum for the insane near Phoenix, a penitentiary at Yuma, and an industrial school for juvenile offenders at Benson.

Population and Divisions.—The first separate census was taken in 1870, giving, exclusive of Indians, 9,658; in 1880, 40,440; in 1890, 59,620 (excluding tribal Indians but including 1,326 others); in 1900, total, 122,931 (71,795 males, 51,136 females, 98,698 native born, 24,233 foreign born, 26,480 Indians, 1,848 negroes, 1,419 Chinese, 281 Japanese). The principal Indian tribes are: Navaho, about 16,000; Papago, 3,900; Pima, 4,400; San Carlos Apache, 2,542; White Mountain Apache, 1,952; other Apache, 600; Mohave, 2,635; Hopi, 1,841; Walapai, 573; Maricopa, 350; Chemehuevi, 250; Havasupai, 243. There are

13 counties in the Territory, as follows, with their county seats, population, etc.:

County	Area sq. mi.	Population 1900	Assessed valuation 1903	County seat	Population 1900
Apache....	10,736	8,297	[illegible]	St. Johns..	.....
Cochise ...	6,147	9,251	[illegible]	Tombstone	646
Coconino...	[illegible]	5,514	[illegible]	Flagstaff ..	1,271
Gila	[illegible]	4,973	[illegible]	Globe	1,495
Graham ...	6,500	[illegible]	[illegible]	Solomonsville.....	629
Maricopa...	8,816	20,457	10,315,111	Phœnix...	5,544
Mohave....	13,421	3,420	[illegible]	Kingman..	.....
Navajo	9,826	8,820	1,387,960	Holbrook .	.....
Pima.......	[illegible]	14,689	3,898,347	Tucson....	7,531
Pinal	[illegible]	7,779	1,653,971	Florence ..	.....
Santa Cruz.	[illegible]	4,545	1,560,307	Nogales ...	1,761
Yavapai ...	7,863	13,799	5,801,017	Prescott...	3,559
Yuma......	9,787	4,145	1,277,571	Yuma	1,519
San Carlos Indian Res'n	......	3,065	....	....	*

* Area included in that of Gila, Graham, and Navajo counties.

In addition to the towns above named, Jerome, in Yavapai county, is a flourishing mining settlement of 2,861 inhabitants.

History.— The first white men to enter Arizona were probably Juan de la Asuncion and Pedro Nadal, two friars of whom little is known, who penetrated the region in 1538. Fray Marcos of Niza and his negro companion Estevanico, in 1539, journeyed from Mexico to the sources of the Rio San Pedro, thence across the southeastern part of the present Territory to the Province of Cibola. (See NEW MEXICO.) In the following year Niza served as guide to Francisco Vasquez Coronado, who, with a considerable force, visited Cibola and sent two small expeditions which discovered the Hopi villages (called Tusayan) and the Grand Cañon of the Colorado. Meanwhile other parties went from the settlement which Coronado established on the Rio Sonora, northwestern Mexico, explored the region, later known as the Papagueria (from the Papago Indians), to the mouth of the Colorado, where letters had been buried by Hernando de Alarcon who commanded a joint expedition by sea and went up the Colorado for 85 leagues. Antonio de Espejo visited the Hopi villages in the northeastern part in 1583, as did Juan de Oñate, the first governor and colonizer of New Mexico, in 1598, the latter also passing entirely across the Territory to the mouth of the Colorado and back in 1604–5. The first missions were established among the Hopis by Franciscans in the summer of 1629, which, barring the killing of some of the missionaries by the Indians, were successfully continued until Aug. 1680, when, in a general uprising of the Pueblos, the missionaries were murdered and little effort made thenceforth to introduce Christianity. From 1687 the Jesuits, particularly Padre Eusebio Kino, made various journeys into southern Arizona, establishing the missions of San Xavier del Bac in 1699 or 1700, and that of Guevavi in 1732. The present church of San Xavier was begun about 1783 and finished in 1797. In 1752 a presidio was established at Tubac, but in 1776 it was removed to a rancheria of about 80 families of Pima, Papago, and Sobaipuri Indians, known as San Agustin de Tucson (the present Tucson) a few miles northward, at which a few Spaniards may also have settled after 1763. The missions and their *visitas* lead a precarious existence after 1750–3, during which years the Pimas were at war against the Spaniards, killing several priests and plundering the missions, including that of San Xavier. The Jesuits were expelled in 1767 and were followed by Franciscans, who rehabilitated the mission settlements and conducted explorations in unknown or forgotten regions. For many years before and after, the Apache tribes were at almost constant war with the more sedentary Indians of southern Arizona, raiding their settlements, killing the men and carrying off the women; nor did the white settlements fare much better, notwithstanding the presence of the presidios. At the time of the conquest of New Mexico in 1846 by Gen. S. W. Kearny, Arizona formed a part of that territory. By the treaty of Guadalupe Hidalgo in 1848 the section north of the Gila was ceded by Mexico to the United States, while that south of the river was obtained through the Gadsden Purchase (q.v.), approved in 1854. Raids continued, various military expeditions were conducted and outposts established, and rich mineral deposits were discovered during the next few years. By act of Congress approved Feb. 24, 1863, Arizona was erected into a separate Territory, and on Dec. 29 it was formally organized at Navaho Springs. The withdrawal of troops from the frontier at the beginning of the Civil War left the country practically at the mercy of Apaches, who continued their depredations; mines were abandoned and settlements deserted, but with the re-establishment of the military posts the development of the Territory was renewed and has since continued. Strenuous efforts have been made for several years toward the admission of Arizona as a state, but thus far without success.

Throughout Arizona are the remains of pueblos and cliff and cave dwellings which were occupied in prehistoric times by the ancestors of the present Pueblo Indians or allied tribes. Noteworthy among the pueblo ruins is the famous Casa Grande in the Gila Valley, near Florence, which was in much its present condition when Father Kino said mass within its walls in 1694. In the northeast, especially in the Cañon de Chelly, are numerous cliff dwellings, remarkably well preserved.

F. W. HODGE,
Smithsonian Institution, Washington, D. C.

Ar'izo'na, University of, a co-educational institution in Tucson, established by act of legislature in 1885, but not opened till 1891. In 1901 its grounds and buildings were valued at $160,000; its library contained 6,000 volumes and its income from the United States government and the Territorial government was $55,000.

Ark, (1) the vessel in which Noah and his family were preserved during the deluge; (2) a term applied to a chest for the safe keeping of valuables.

The Ark of the Covenant, in the Jewish synagogue, was the chest or vessel in which the tables of the law were preserved. This was 3 feet 9 inches in length, 2 feet 3 inches in breadth, and the same in height. It was made of shittim wood, overlaid within and without with gold.

Arkansas, är'kăn-sâ, "The Bear State," a south-central State of the United States (No. 12 in order of admission); bounded north by Missouri, south by Louisiana, east by Mississippi River, west by Indian Territory, southwest by Texas; a block 3° 30′ north to south, about 250 miles land measure, breadth 175 to 275 miles; area 53,850 miles (No. 23 in United States), 805 water; pop. 1,311,564 (No. 18 in United States), or 24.7 to square mile (No. 29 in density). White, 944,580; colored, 366,984.

Topography.— The eastern side is the Mississippi alluvium, swamps, "lakes," and bayous, overflowed by the rises of the great river despite a vast system of levees or dikes; in the centre it slopes west and south to the rolling uplands and the many east-and-west divisions of the Ozark Mountains (q.v.) — a broken range of low hills with some peaks as high as 3,200 feet, as, for instance, Magazine Mountain, in Logan County. This and other mountains, including the Ouachita Hills, are in the southern part of the State. The most extensive range is that known as the Boston Mountains, in the northwestern part of the State. The upper mountainous, forest, and mineral lands may be separated from the northeast corner of the State to Little Rock, thence south 100 miles, thence to the southwest corner of the State. East of this line the country is hilly, thickly covered with pines, oaks, and other trees until the alluvial soil is reached, extending from the Mississippi westward from 40 to 50 miles in width.

River Systems.— The State is evenly divided by its great name-river (q.v.). Just above its mouth and connected with it by a bayou through the bottoms, the White River, 800 miles long, also enters the Mississippi; rising in northwest Arkansas, it flows through southern Missouri and returns to its own State, receiving at Jacksonport the Black of 400 miles, and near Clarendon the Cache. Farther north the St. Francis of 450 miles comes from Missouri, winds through the delta plains for a long distance nearly parallel to the Mississippi, and enters it just above Helena; the space between them is a mass of cypress swamps and bayous. The southern half is drained by the Ouachita of 500 miles, feeding the Red in Louisiana, and in the extreme southwest by a bend of the Red.

Climate and Sanitary Conditions.— The eastern river bottoms are hot and malarious; but the rest of the State is unsurpassed for healthfulness, and the Ozarks are a noted sanatorium for lung diseases. Mean winter temperature about 38.5; summer, 80. Mean rainfall, in the centre, 50 to 60 inches; in the extreme west, 46.5 inches. The drouths of the farther West and the severe northers of Texas are alike unknown.

Geology, Minerals, and Mining.— The Ozarks are the western extension of the Appalachian system, formed at the same time by the same forces: their basis is Palæozoic,— Lower Silurian in the north, Sub-Carboniferous on the south,— with a patch of Cretaceous in southwest. The southern portion of the State, a part of the great Atlantic belt of coastal plain, lies upon a foundation of Tertiary, overlaid with Quaternary sands and clays. The former make the State one of remarkable richness in mineral wealth. The Ouachitas furnish the silicious novaculite, whence are made the famous "Arkansas" or "Ouachita" oilstones, the finest for sharpening tools in the world; quarried in Hot Springs, Garland, and adjoining counties since 1840; the coarser grades of which and quartzites supply common whetstones, grindstones, burr millstones, etc. They also contain bauxite, a granular clay-ore now the principal source of aluminum, used also for alum and crucibles; building, porcelain, and fireclays. In the northwest are quarried limestone for lime, quartz sand for glass, building sandstone, granite, and slate; and a valuable pink marble called "St. Clair limestone." In the north centre around Batesville, manganese ore is mined for eastern steel works. There is a rapidly increasing production of semi-anthracite coal, which, almost neglected prior to 1885, had risen to $1,687,000 in 1900; lignite has been found, and petroleum, and natural gas. Phosphates, mineral ochres, and salt are found. There are large deposits of marble of many colors in the north part of the State. A railway will soon make these, as well as zinc extracted from valuable and numerous mines in the same section, extensive articles of commerce. There are also in the southern portion of the State large deposits of asphalt, graphite, and inexhaustible deposits of that species of chalk from which Portland cement is made, which is now manufactured on an extensive scale. Zinc ore is an article of some export, and galena, gold, copper, and nickel exist in some quantity, as well as limonite iron ore and salt. More valuable at present are the mineral springs, of which those at Hot Springs have developed a celebrated sanatorium and town.

Soils, Agriculture, and Forests.— Agriculturally the most valuable soil is found in the river bottom-lands, and as the surface rises from these the soil becomes less productive. There are large submerged tracts that only require proper drainage to make them valuable to the farmer.

The extreme fertility of the soil in most parts renders agriculture highly profitable. A raw, sparsely settled State at the time of the war, with less than a third its present population, and that mainly along the great navigable streams, most of it had no old industrial system to be wrecked and remade, but was virgin soil; hence it recovered much faster than other southern States, and when railroads opened it up, the new free-labor system developed it with few obstacles, and the improved farm land has increased from about one twentieth to about one fifth of the entire area, or from some 1,700,000 to close on 7,000,000 acres, one eighth of it in the last decade; two fifths of the State is in farms and half of their acreage improved. It has been a growth almost wholly in small farms; from an average in 1860 of nearly 250 acres, it has sunk in 1900 to 93. A part of this is no doubt due to the small patches rented by the negroes, whose farms average only half the size of the whites, and who comprise one fourth of the farmers.

The northwestern Ozark region has a thin, sandy soil, poor relatively to the rest, which range through the clays and loams of the limestone uplands, the sandy loam of the western Arkansas valley, and the clay and sand of the eastern valley, to the deep black soil of the bottoms, the famous buckshot soil (the incredibly fertile cotton land), and the sticky red "gumbo"

clay of the Red River valley. Yet the first-named section is a superb fruit district, two northwestern counties raising in 1899 1,173,642 of the total 2,811,182 bushels of apples (an almost fourfold increase in the decade), and 3,500,-000 of the 44,000,000 bushels of corn, and two others (one the same) more than half the 12,667,-740 quarts of strawberries. Of the other fruit crops for which the State is becoming famous, the peach crop of 333,642 bushels was raised in the southwest, over one sixth in one county just below the Ouachitas; the same counties chiefly grew the plums, prunes, and grapes, the latter 3,621,000 pounds. Dried and canned fruits amounted to 2,045,910 pounds. Potatoes and sweet potatoes are grown all over the State, but about one fourth came from three counties in the western Arkansas valley. But of course the chief crop is cotton, grown mainly in the south, and of which the crop was 705,928 bales in 1899, and 819,000 in 1900, making the State No. 5 in the United States. Hay and forage play a considerable part; these imply animals, and naturally horses, asses, and mules, for farm work, have multiplied rapidly with the farms; swine also have increased, but neat cattle, milch cows, and sheep have fallen off. Sorghum, though still a considerable crop, has diminished two fifths in the decade. An important industry is rose-culture for perfume, and flowers for seed.

The forested area of the State is three fourths its entire surface — more than 40,000 of its 53,850 square miles, and of a vast variety of hard and soft woods: dense tracts of pine, white and other oaks, hickory, black walnut, hornbeam, locust, pecan, ash, elm, willow, papaw, etc. The St. Francis valley, once a continuous swamp, has been reclaimed and is covered with a heavy growth of cypress, gum, oak, hickory, and sycamore. In the Arkansas valley are red cedar, cottonwood, maple, and various oaks. In all forest products the State has a great industrial future: the value of raw and manufactured forest products in 1900 was about $28,700,000.

Manufactures.— Though this branch of industry is relatively small in Arkansas as yet, its rapid increase,— more than doubling in the decade, from $17,275,192 in 1890 to $37,006,409 in 1900,— and the great forest and mineral basis for it, foreshow a great future. Naturally, over two thirds of it was of wood products; $23,959,-983 in lumber and timber, $2,266,522 in planing-mill stuff, sash-and-blind work, wheel parts, staves, shingles, cedar posts, etc. These were but $8,943,052 and $1,761,932 in 1890. Next to this is the group of cotton industries,— ginning, and making cottonseed oil and cake; the latter produced a value of $2,874,864, against $1,881,-668 in 1890, the former of $1,261,097, though in 1890 only $153,226. Flouring and grist-mill products were $3,708,709, against $2,498,168 in 1890; steam-car construction and repair-shop work, $2,095,447, against $1,299,558. Brick and tile formed another important item. There were altogether 4,794 establishments, employing 28,-150 persons, paying $9,937,387 in wages, and having an output of $45,197,731. The internal revenue collections on taxable manufactures now amount to about $300,000 per annum.

Commerce and Navigation.— The immense extent of its internal waterways, in which it exceeds every other State, compensates Arkansas for lack of a seaboard. The Mississippi is equal to one, however, giving it deep-water communication with the ocean and with the other States of the valley. The Arkansas is navigable its entire course in the State, some 400 miles; the White for 250 miles or so to Jacksonport; the Ouachita and the Red rivers also afford navigation. The real port of Arkansas is New Orleans, and its exports are lumber and cotton.

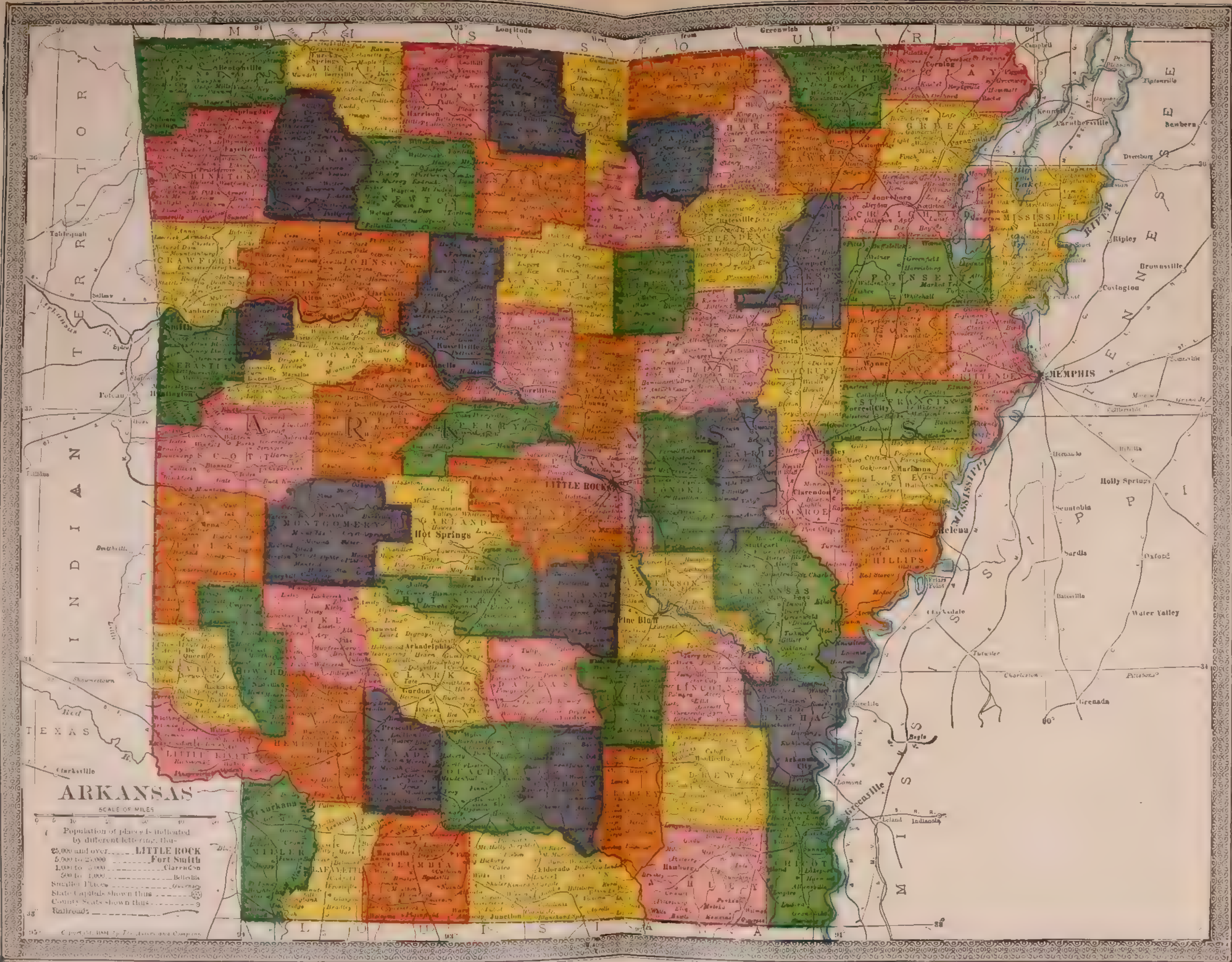
Railroads and Street Railways.— The slender population of Arkansas and its concentration along the rivers made railways long unnecessary and undesired, and the first one was under construction when the Civil War broke out, with only 38 miles built; in 1870 there were but 256, in 1880 859. The next decade was its real creation as a serious system, and in 1890 it had risen to 2,203.44; slackening for a few years,— 2,439.20 in 1895,— it was 3,082.27 in 1899, and in the next two years 158 more were built, making 3,240.33 in 1901. There are 39 lines in the State, or one to every 16 square miles and 310 people. The rates are controlled by a State railroad commission.

There are five lines of street railway operating 200 miles of track.

Banks.— In 1902 there were seven national banks in Arkansas, with $1,070,000 capital, $336,-000 outstanding circulation, $3,108,000 deposits; $1,003,000 reserve; 39 State banks with $1,243,000 capital, $6,604,000 assets, and $4,464,000 deposits. There is one clearing-house in the State at Little Rock; exchanges in 1901, $34,808,284.

Finances.— The assessed valuation in 1901 was $127,062,903; in 1897, $117,873,253. Annual tax rate, 1.19 mills. Recognized public debt, $1,271,000 at 3 per cent, of which $1,113,000 is permanent school fund, not properly an indebtedness as it can never be paid; unrecognized, $8,-706,773. In 1900 a twenty years' dispute with the United States over its holding of Arkansas bonds, to which the State claimed an offset of damages by failure of the United States to patent 273,000 acres of swamp land to it, was settled by paying to the United States $160,000 and guaranteeing titles to settlers.

Education.— The interest on the permanent school fund (see preceding paragraph), a 2-mill State school tax, and other revenues, amounted in 1900 to about $500,000, the district taxes to $805,000, and the poll tax to $163,000; total, toward $1,500,000, of which only $1,369,000 was expended. There are upwards of 5,000 schools, with over 7,000 teachers, three fifths males, the largest percentage in the United States. But the support is inadequate, the terms average only 70 days yearly,— among the lowest in the country,— and there is no general school superintendence, each locality managing its own and the quality fluctuating with its wealth and public spirit. The almost wholly rural character of the population, here as everywhere, makes the school problem difficult from the dispersion of the pupils. From all these causes, in 1900, of 319,742 white children from 5 to 17, only 185,-490 attended school even for the short terms; and of 123,242 colored children, only 50,386. Yet Arkansas has 10 other States below it in illiteracy. There are 48 public high schools and 24 private secondary schools, besides 7 private normal schools (there are no State ones), and 9 universities and colleges, some co-educational, as follows: Arkansas College, Presby-



ARKANSAS
SCALE OF MILES
Population of places is indicated by different lettering, thus:
25,000 and over LITTLE ROCK
5,000 to 25,000 Fort Smith
1,000 to 5,000 Clarendon
500 to 1,000 Belleville
Smaller Places
State Capitals shown thus
County Seats shown thus
Railroads
INDIAN TERRITORY
TEXAS
MISSOURI
TENNESSEE
MISSISSIPPI
LITTLE ROCK
MEMPHIS
Hot Springs
Pine Bluff
Helena
Greenville
Texarkana
Arkadelphia
Jonesboro
Holly Springs
Grenada
Water Valley
Oxford
Sardis
Ripley
Brownsville
Covington
Tahlequah
MISSISSIPPI RIVER

terian (1872); Arkansas Industrial University, n.-s. (1872); Philander Smith College, Methodist (1877); Hendrix College, Southern Methodist (1884); Ouachita College, Baptist (1886); Arkadelphia College, Methodist (1890), Arkansas Cumberland College, Presbyterian (1891); Mountain Home College, Baptist (1893); and Central Baptist College for Women, at Conway.

Churches.— The Methodist, Roman Catholic, Episcopalian, Presbyterian, and Baptist are the leading church bodies in Arkansas, as in most other southern States.

Charitable and Penal Institutions.— The only ones of the first class are a lunatic asylum and a deaf-mute school; of the latter, a penitentiary in Pulaski County. There is no reform school for juvenile offenders, who are confined with the older criminals.

Post-offices and Periodicals.— There were 1,859 post-offices of all grades in 1900, and 259 periodicals, 21 daily, 212 weekly.

State Government.— The Constitution is of 1874, amended 1893. Suffrage requires a year in the State and payment of poll tax. Office-holding and being witness in court require belief in God. The governor, State officers, and State representatives hold for two years. The governor has $3,500 salary; his veto is overruled by a majority in each House; if he dies within a year from election a fresh one is held, if later the president of the Senate fills out his term. The legislature meets biennially, session limited to 60 days,— but a two thirds vote of each House may extend it, and the governor may call a special session; the representatives must be at least one from each county, and not exceed 100; the Senate has 30 to 35 members (at present 32), four-year terms; both receive $6 a day and mileage. The Supreme Court has five members elected for eight years; there are circuit courts with judges elected for four years; and the usual county and probate courts. The legislature has power to establish new ones or extend the jurisdiction of old.

State Militia.— There are 1,900, 1,600 being infantry. No county may have over four companies.

Representatives in Congress.— There are seven, under the apportionment of the census of 1900, previously six.

Politics.— The State is overwhelmingly Democratic.

Population and Divisions.— At the first census, of 1820, Arkansas had 14,273 people; 1830, 30,388; 1840, 97,574; 1850, 209,897; 1860, 435,450; 1870, 484,471; 1880, 802,525; 1890, 1,128,179; 1900, 1,311,564. The colored population of 366,984 has increased 75 per cent since 1880, against about 60 per cent for the white. The foreign population is inconsiderable. Only 6.9 per cent of the people live in towns of 4,000 and over, and only 9 per cent in those of 2,000 and over.

There are 75 counties in Arkansas, as follows, with their county seats:

Arkansas, Dewitt.
Ashley, Hamburg.
Baxter, Mountainhome.
Benton, Bentonville.
Boone, Harrison.
Bradley, Warren.
Calhoun, Hampton.
Carroll, Berryville.
Chicot, Lake Village.
Clark, Arkadelphia.
Clay, Corning.
Clebourne, Heber.
Cleveland, Rison.
Columbia, Magnolia.
Conway, Morrillton.
Craighead, Jonesboro.
Crawford, Vanburen.
Crittenden, Marion.
Cross, Vanndale.
Dallas, Princeton.
Desha, Arkansas City.
Drew, Monticello.
Faulkner, Conway.
Franklin, Ozark.
Fulton, Salem.
Garland, Hot Springs.
Grant, Sheridan.
Greene, Paragould.
Hempstead, Washington.
Hot Springs, Malvern.
Howard. Centerpoint.
Independence, Batesville.
Izard, Melbourne.
Jackson, Newport.
Jefferson, Pine Bluff.
Johnson, Clarksville.
Lafayette, New Lewisville.
Lawrence, Powhatan.
Lee, Marianna.
Lincoln, Star City.
Little River, Richmond.
Logan, Paris.
Lonoke, Lonoke.
Madison, Huntsville.
Marion, Yellville.
Miller, Texarkana.
Mississippi, Osceola.
Monroe, Clarendon.
Montgomery, Mt. Ida.
Nevada, Prescott.
Newton, Jasper.
Ouachita, Camden.
Perry, Perryville.
Phillips, Helena.
Pike, Murfreesboro.
Poinsett, Harrisburg.
Polk, Mena.
Pope, Russellville.
Prairie, Desarc.
Pulaski, Little Rock.
Randolph, Pocahontas.
St. Francis, Forrest City.
Saline, Benton.
Scott, Waldron.
Searcy, Marshall.
Sebastian, Greenwood.
Sevier, Locksburg.
Sharp, Evening Shade.
Stone, Mountainview.
Union, Eldorado
Van Buren, Clinton.
Washington, Fayetteville.
White, Searcy.
Woodruff, Augusta.
Yell, Danville.

Chief Cities.— There are only eight places of 4,000 and over, the three largest being on the Arkansas. The one considerable city is the capital, Little Rock, 38,307; a manufacturing and railroad centre, on the first high ground above the Arkansas bottom lands. The chief of the remainder are Fort Smith, 11,587, where the river emerges from Indian Territory; Pine Bluff, 11,496, half way from Little Rock to the mouth of the river; Hot Springs, 9,973, a noted sanatorium, in the western centre just north of the Ouachita; Helena, 5,556, on the Mississippi below Memphis; and Texarkana, 4,914, in the southwest on the border of Texas.

History.— It has almost none till the 19th century. De Soto's expedition furnished the first white men to set foot on it, and De Soto himself was not improbably buried in Arkansas River. The first French explorers found here an Indian tribe called the Arkansaw, which they spelled in French fashion, Arkansas. In 1685 Bienville's Frenchmen camped for a while at Arkansas Post, in the Arkansas River bottoms near the White and the Mississippi. In 1720, as part of John Law's famous "Mississippi scheme," he was granted by the Regency 12 square miles on the Arkansas River, on condition of settling 1,500 Germans there and protecting them against the Indians; but the scheme ended with Law's failure, and the few who did come settled elsewhere. The district when finally dotted with a few settlements was in French hands till the Louisiana Purchase in 1803, of which it formed part; in 1812 it was made part of Missouri Territory, and in 1819 organized as Arkansas Territory, which included Indian Territory. At this time the entire population, including Indians, was not above 10,000; yet in November 1819 the Arkansas *Gazette* was founded at Little Rock; and settlers began at once to flow in. On 15 June 1836 it was admitted to the Union as a slave State, paired with Michigan as a free State, though the latter's formal admission was a few months later. Though slave and of southern settlement, the hill-country farming divided it in sentiment in 1860, and there was a violent struggle between the Union and secession element; but in January 1861 the latter succeeded in calling a secession convention, by 27,412 to 15,826. The

State officers anticipated them by securing Fort Smith, and the Federal arsenals at Napoleon and Little Rock; but on Lincoln's call for troops, the convention met and on 6 May passed a secession ordinance. In 1862 the Confederate forces were defeated at Pea Ridge, 6-7 March, and Prairie Grove 7 Dec.; Helena and Arkansas Post fell into Union hands, and 4 Sept. 1863, Little Rock was captured and the State reclaimed for the Union. The loyalists then held a convention in January 1864, framed a constitution, adopted it by a purely loyalist vote, elected congressmen and State officers, and organized a regular government; but Congress refused to accept it or admit the State again. Under the Reconstruction Act of 1867, a constitution was adopted in March 1868, and the State readmitted 22 June. Several counties were again put under military rule in 1868. The anarchy under the carpet-bag régime culminated in a civil war in April 1874, in which the United States was invoked. A new constitution was adopted in 1874, under which the State now works.

U. M. Rose,
Ex-President American Bar Association.

Ar'kansas City, Kan., a city of Cowley County, near the southern border of the State, on Arkansas River, near the Walnut River, and furnished with water power by a canal uniting them. It was settled 1870, and incorporated 1872. It manufactures agricultural implements, windmills, wire mattresses, flour and lumber; and has a large trade with Indian posts and agencies in Oklahoma and Indian Territory. It contains a United States Indian School. Pop. (1900) 6,140.

Ar'kansas Post, Ark., a village in Arkansas County; on the Arkansas River; 117 miles southeast of Little Rock. It is on a high bluff and was the site of the first settlement made within the present limits of Arkansas by French missionaries in 1685. Its elevated location gave it considerable military importance during the Civil War. The Confederates established strong works here, which were reduced by a combined assault of a portion of the Federal army, under Gen. McClernand, and a naval command under Admiral Porter, on 11 Jan. 1863.

Ar'kansas River, the largest affluent of the Mississippi save the Missouri; length, nearly 2,000 miles; area of basin, 189,000 square miles; mean discharge, 63,000 cubic feet. It rises in the central Colorado; flows east with a rapid current through deep, narrow cañons, and over a rocky bed till it emerges on the naked, arid plains of eastern Colorado and western Kansas; runs east several hundred miles in Kansas, and turning southeast leaves it near Arkansas City. It then cuts a cantle off Oklahoma and Indian Territory,— where it receives the Cimarron and the broad shallow Canadian from the west, with the Verdigris and Neosho from the north,— and becomes navigable 650 miles to its mouth in Arkansas (which it bisects).

Ar'kansas Stone, a name given to the oilstones made from two grades of novaculite quarried in Hot Springs, Garland County, and also in adjoining counties in Arkansas. The rocks cover a large area and yield the finest whetstones. From them the highest grades of both whetstones and razor hones are made.

Ar'kansas, University of, a State institution organized in 1872, with academic and technical departments in Fayetteville; law and medical departments in Little Rock, and a normal school for colored students in Pine Bluff. At the close of 1901 it had 37 professors and instructors, 1,150 students and 681 graduates. It has a library of 10,000 volumes, and an income of $70,000, while its grounds and buildings are valued at $300,000.

Ark'low, Ireland, a town in the county of Wicklow, 14 miles south-southwest of the town of that name, on the right bank of the Avoca, which falls into the sea about 500 yards below the town, and is here crossed by a bridge of 19 arches. It is inhabited principally by fishermen. There are remains of an old monastery, and of the castle of the Ormonds, the latter destroyed by Cromwell in 1649. Here in 1798 the United Irishmen suffered a defeat. Pop. (1901) 4,172.

Arko'na, the northeast promontory of the German island of Rügen, in the Baltic. Its chalk cliffs rise to a height of 177 feet, topped with a lighthouse, built in 1827, from which the Danish island of Möen, 33 miles northwest, can be seen. Here stood the famous fortification (Slavonic, *Urkan*) so long impregnable, and the temple of the Wend deity Swantewit, the most sacred sanctuary of the Slavs of northern Germany.

Arkose. See Sandstone.

Ark'wright, Sir Richard, a famous English inventor: b. in Preston, Lancashire, 23 Dec. 1732; d. 3 Aug. 1792. He was the youngest of 13 children, and was bred to the trade of a barber. His residence in a cotton-spinning district (Bolton), drew his attention to the operations of that manufacture; but he was 35 before he devoted himself to consideration of the subject. The *spinning-jenny*, invented in 1767 by Hargreaves, gave the means of spinning 20 or 30 threads at once with no more labor than had previously been required to spin a single thread; but the thread spun by the jenny could not, however, be used as warp, being destitute of the firmness required. Arkwright supplied this deficiency by the invention of the *spinning-frame*, which spins a vast number of threads of any degree of fineness and hardness, leaving the operator merely to feed the machine with cotton, and to join the threads when they happen to break. His invention introduced the system of spinning by rollers, the carding, or *roving* as it is technically termed (that is, the soft loose strip of cotton), passing through one pair of rollers, and being received by a second pair, which are made to revolve with three, four or five times the velocity of the first pair. By this contrivance the roving is drawn out into a thread of the desired degree of tenuity, a twist being given to it by the adaptation of the spindle and fly of the old flaxwheel to the machinery. The precise date of his invention is not known; but it is most probable that the idea of spinning by rollers had occurred to his mind as early as the period when Hargreaves was engaged in the invention of the jenny. He removed to Nottingham in 1768, in order to avoid the attacks of the lawless rabble who thought his machines would deprive many workmen of a livelihood. Arkwright erected his first mill, which was driven

SIR RICHARD ARKWRIGHT.

FAMOUS FOR INVENTIONS IN COTTON SPINNING.

by horses, at Nottingham, and took out a patent for spinning by rollers, in 1769. He built a second factory on a much larger scale at Cromford, in Derbyshire, in 1771, the machinery being turned by a waterwheel, and having made several additional discoveries and improvements, took out a fresh patent for the whole in 1775, thus completing a series of ingenious and complicated machinery. When the importance of his inventions became known efforts were made to have the patent set aside, and in 1781 Arkwright commenced actions against a number of persons for invading his patent. Only one cause was tried, that against Col. Mordaunt in the Court of King's Bench in July 1781; and in that the verdict went against Arkwright on the ground of defective specification. In February 1785, a second action was tried in the court of common pleas, in which Arkwright brought a number of persons to prove that they could make machines from his specifications, in consequence of which he obtained a verdict in his favor. This producing great alarm among many who had erected machines for cotton spinning, and from whom a royalty was demanded, in order to settle the dispute a suit was brought against Arkwright in the Court of King's Bench, in which the whole question was argued, not only as to the intelligibility of his specification, but on the less technical and more important ground of his not being himself the inventor of the machines for which he had obtained a patent. After a long and ably-conducted trial a verdict was given against Arkwright, and in November 1785 the patent was cancelled. None of Arkwright's most intimate friends, or those best acquainted with his character, ever had the slightest doubt with respect to the originality of his invention. In 1786 Arkwright received the honor of knighthood from George III., and unlike many inventors, he amassed a large fortune by his inventions.

Arlberg, a mountain pass between the Rhætian and the Lech Alps, in the west of Tyrol; between it and Vorarlberg, pierced by the third longest railway tunnel in the world. It is six and one half miles long, was finished in November 1883, and connects the valley of the Inn with that of the Rhine, and the Austrian Railway system with the Swiss railways.

Arles (ancient, *Arelate*), a town in France on the Rhone, about 25 miles from its mouth. It stands on a rocky limestone eminence, sloping to the river, and has irregular streets, presenting many interesting features. In a large square is an ancient granite monolith, and among other remarkable objects are the Romanesque Cathedral of Saint Trophimus, with a fine portal and some good paintings and sculptures; and especially numerous ancient remains, of which the most conspicuous are those of a Roman amphitheatre, which accommodated 24,000 spectators, and those of a Roman theatre. It has railway workshops, but its manufactures are unimportant, though its trade is important. Arles was founded several centuries before the Christian era and was the chief colony of Massilia (Marseilles). In the 4th and 5th centuries several church councils met here. From 897 to 1150 it was the capital of a kingdom bearing its name. Pop. (1901) 15,506.

Arlincourt, är'län-koor', **Charles Victor Prevôt, Vicomte d',** a French poet and novelist: b. in 1789; d. in 1856. His chief poetical work is 'Charlemagne, or the Caroleid' (1818), an epic; and of his novels the most successful was 'Le Solitaire' (1821), which was translated into all European languages. Among several pamphlets, written in support of the Legitimist cause in 1848, one entitled 'God Wills It' went through 64 editions.

Ar'lington, Henry Bennet, Earl of, an English politician: b. in 1618; d. in 1685. He was a member of the "Cabal" ministry and as Secretary of State was of much influence in public affairs.

Ar'lington, Mass., a town in Middlesex County, about seven miles northwest of Boston. It contains several fine buildings, among which is a library given to the town by Mrs. Eli Robbins at a cost of $200,000. The town has electric lights and car service to Boston. It was settled about 1650 and received its present name in 1867. Pop. (1900) 8,603.

Ar'lington Heights, a range of hills in Fairfax County, Va., on the Potomac, opposite Washington. They were strongly fortified during the Civil War. Gen. Robert E. Lee's estate here is now the site of a national soldiers' cemetery.

Arlon, är'lôn, a town in Belgium, the capital of the province of Luxembourg, in the midst of the woods and mountain ridges of the Ardennes. It is a thriving place, with manufactures of ironware, leather, tobacco, earthenware, and clay pipes. It appears in the Antonine Itinerary, and from the coins, inscriptions, and other antiquities found, must have possessed some importance even in the time of the Romans. It is mentioned under its present name in 870, in connection with the partition of Lorraine. Pop. (1899) 7,997.

Arm, a term technically applied to that portion of the upper extremity of the body extending from the shoulder joint to the elbow, but popularly used to denote both arm and forearm. The arm proper has one large and strong bone, the humerus, covered by strong muscles, which protect the blood vessels and nerves. The upper end of the humerus fits into the head of the scapula and with the clavicle forms the shoulder joint. The head of the humerus is held in the joint partly by ligaments, but mainly by the muscles attached to it. The motions of the arm are many. Those muscles that move the arm inward toward the chest are known as the adductors. These are the pectoralis major, coraco brachialis, which also flex the arm, and the latissimus dorsi and teres major, which also extend the arm. The arm is moved away from the body by the deltoid, a large muscle on the outer side, and the supraspinatus, a smaller muscle going from the scapula. The arm is rotated outward by the infraspinatus and the teres minor, and rotated inward by the subscapularis. All of these muscles are fastened about the upper part of the humerus. The greater mass of the muscles of the arm are those that go to the forearm and that move that member. Those that flex the forearm, or bend the elbow, are the biceps, the brachiates and the brachio-radialis, the former being the most important. It also aids in turning the forearm,

palm downward. The muscles that extend or stretch the forearm are the triceps and the anconeus. There are other movements of the forearm. The arm having two bones, the radius and ulna, one turns on the other and the movements of pronation and supination are produced. Pronation is accomplished by two muscles, the pronator teres and the pronator quadratus; the supinator makes the movement outward. The movements of flexion and extension take place in the elbow joint, which is hinged like those of pronation and supination, just below the elbow joint, the radius moving on the ulna. The union of the radius and ulna with the bones of the wrist make a hinge-like joint, the wrist joint. Movements at the wrist are in four directions, flexion and extension, abduction and adduction. These movements, as well as those of the fingers, are made by a large group of muscles some 20 in number. There are in all 48 muscles concerned in the movements of the arm, forearm, and hand. The blood supply of the arm is derived from the brachiocephalic of the right side and from the arch of the aorta on the left (see AORTA) in a single main trunk that divides at the bend of the elbow. The first portion is called the subclavian and is not in the arm proper, the axillary, or second portion, begins at the outer border of the first rib and becomes the brachial just about the armpit, where it may be felt and compressed. The brachial artery is the great trunk of the arm. It may be felt just inside of the inner edge of the biceps muscle about the middle and there may be readily compressed in case of hemorrhage. At the bend of the elbow the brachial artery divides into the radial and ulnar, which supply the outer and inner sides of the forearm respectively. The radial artery is the one most frequently felt in determining the pulse; the ulnar may be used but as it lies deeper it is felt less easily. In the hand these arterial branches anastomose to form a superficial and a deep palmar arch from which branches go to supply the fingers. Hemorrhages in the palm of the hand can be controlled therefore only by controlling both radial and ulnar arteries, or better, by controlling the brachial just above the bifurcation in the elbow. This may be done by strongly flexing the forearm or something held against the artery. The principal veins of the forearm are the ulnar, the median, and the radial; of the arm the cephalic and the basilic. These empty into the axillary vein, and this into the subclavian. The nerve supply of the arm is derived from the spinal cord from the fifth, sixth, seventh, and eighth cervical, and the first, second, and third thoracic nerves. These form a complex plexus, the brachial plexus. The main branches going to the different muscles and supplying the skin areas are the median, ulnar, musculo spiral, musculo cutaneous, and circumflex. Their distribution is extremely complex.

Armada, är-mā'da or är-mä'da, the Spanish name for any armed force, especially a naval force. The term *Spanish Armada* is applied to that great naval armament which Philip II., in 1588, fitted out under the command of the Duke of Medina-Sidonia and Martinez de Recaldo, against Queen Elizabeth, with the view of conquering England, which Pope Sixtus V. had bestowed upon Spain. The fleet consisted of 131 great and many smaller ships of war, and carried 19,000 marines and 8,000 sailors. The ships had scarcely quitted Lisbon on 29 May 1588 when they were scattered by a storm and had to be refitted in Corunna. Advancing in the form of a half-moon of seven miles in extent, it came in sight, off Plymouth, of the English fleet, scarcely numbering 80 sail, and commanded by Lord Howard, who, endeavored by dexterous seamanship, and the discharge of well-directed volleys of shot at alternately long and short distances, to damage the vessels of the enemy. Some of these, including the galleon laden with treasure, fell into the hands of the English or were destroyed. Arrived at length off Dunkirk, on the 7 August the armada was becalmed and thrown into such confusion by the arrival in the fleet of eight fire-ships sent by the English admiral, that on the morning of the 8th Lord Howard was enabled to attack it on several sides. Notwithstanding a brave resistance, many of the Spanish vessels were destroyed or fell into the hands of the English and Dutch, and in consequence the Duke of Medina-Sidonia resolved to abandon the enterprise, conceiving the idea of conveying his fleet to Spain by a voyage round the north of Great Britain. A hurricane which now broke forth with tremendous violence on the already dispirited Spaniards, scattered their ships in all directions. Some went down on the cliffs of Norway, others in the open sea, and still others on the Scottish coast. About 30 vessels reached the Atlantic Ocean, and of these several were driven by a west wind on the coast of Ireland and wrecked. In all, the armada is said to have lost in the open sea 72 large vessels, exclusive of smaller craft, and 10,185 men, while every family of distinction in Spain had to mourn the loss of one or more of its members. Only about 50 vessels reached Spain on the return voyage.

Bibliography.— Corbett, 'Drake and the Tudor Navy'; Creasy, 'Fifteen Decisive Battles'; Froude, 'The Spanish Story of the Armada'; Gardiner, 'Historical Biographies: Drake'; Green, 'History of the English People'; Motley, 'History of the United Netherlands.'

Ar'madale, the title of a novel by Wilkie Collins (1866). The plot of this, like that of 'The New Magdalen,' and other of its author's later novels, is a gauntlet of defiance to the critics who had asserted that all the interest of his stories lay in the suspension of knowledge as to the dénouement. The machinery is in full view, yet in spite of this disclosure, the reader's attention is held until he knows whether the villain or her victims will come out victorious.

Ar'madil'lo (Sp. dim. of *armada,* armed, referring to its bony shell). 1. A. edentate mammal of the family *Dasypodidæ,* found in South and Central America and notable for its defensive armor. This armor consists of small roundish bony plates, ossified within the skin, and united to form solid shields, one over the shoulders, one over the haunches, and, between these two, transverse bands of movable plates, which protect, but leave freedom of motion, to the trunk of the body. These plates are overlaid by a thin, horny pellicle, and between them grow hairs varying in length and amount with the species, from almost none in some to a coat in others, hiding the shell; and the unarmored

1. Pangolin (Manis pentadactyla).
2. Three-banded Armadillo (Tolypeutes tricinctus).
3. Aard-Vark (Orycteropus afer).
4. Pichiciago (Chlamydophorus truncatus).
5. Tamandua (Tamandua tetradactyla).
6. Great Ant-Eater (Myrmecophaga jubata).

ventral surface is also hairy. The head is provided with a shield entirely separate from that of the shoulders, and in some species even the tail is protected by bands of plates. The various forms of armadillos are distinguished largely by the number of movable thin bands of plates lying between the large fixed anterior and posterior shields, up to as many as a dozen in the cabassous (*Xenurus*). This armor serves the purpose of defense, and some of the tribe (only those of the genus *Tolypeutes,* however), increase its value by exercising the power of rolling themselves up into a ball so that the tender under parts of the body may be completely protected. This ability depends upon the number of bands in the central portion of the armor-case. Although true Edentates, these animals have a few small, useless teeth, without true roots; the tongue is covered with a sticky fluid like that secreted by the tongue of an ant-eater, but it is not protrusile.

The armadillos are timid, nocturnal animals, living on insects, carrion, and vegetable matter; their legs and claws are adapted to burrowing, and, when pursued, they usually bury themselves more quickly than the pursuer can follow them. Only one species (*Dasypus villosus*) is sufficiently adaptable to hold its own when a wild region is settled; the others soon disappear. One of the most interesting of them all is the pichichago (*Chlamydophorus truncatus*), found in Argentina, which lives entirely underground like a mole, and exhibits a peculiar structure in many ways, the body having an appearance of truncation, as if the hinder part had been cut squarely off, instead of ending in curved lines. It is very small, only five to six inches long, while the giant armadillo (*Priodon gigas*) measures three feet, exclusive of the tail. Some of the armadillos range north and south as far as Texas and Argentina; among these is the peba, or nine-banded armadillo (*Tatusia novemcincta*). The family is divided into several genera and the species are numerous and are known as peludos, cabassous, apars, etc., elsewhere described. They are eaten by the South Americans and even esteemed delicate, but their flesh is usually so flavored by the insects and decayed matter which they eat that only a few vegetable-eating species are inoffensive to an unaccustomed palate.

Many forms of fossil armadillos are known from both North and South America, a fossil species of Dasypus having been six feet long. Another genus was *Eutatus*, which had a shield formed of 36 distinct bands, of which the last 12 were soldered together. These lead back to the large group *Gravigrada*. (See also Glyptodon; Mylodon.) Good accounts of the armadillos are given in both the ‘Standard’ and the ‘New (Royal)’ Natural Histories. Consult also Hudson's ‘Naturalist on the La Plata’ (1892); Alston's ‘Biologia Americana Centrali’; ‘Mammals’, (1879–82), with colored plates; Azara's ‘Historia Natural de los Paxaros del Paraguay’ (Madrid, 1805); ‘Mammals of Uruguay’ in the Proceedings of the Zoological Society of London for 1894.

Ar'madil'lo, in entomology. See Wood-lice.

Armageddon, ăr'ma-gĕd'dŏn, the great battlefield where occurred the chief conflicts between the Israelites and their enemies. The name was applied to the tableland of Esdraelon in Galilee and Samaria, in the centre of which stood the town Megiddo, on the site of the modern Lejjun; used figuratively in the Apocalypse to signify the place of “the battle of the great day of God.”

Armagh, är-mä', a county of Ireland, in the province of Ulster. The northern part of the county, bordering on Lough Neagh, consists principally of extensive bogs of great depth, with a remarkably black soil. The manufacture of linen is carried on very extensively. The chief towns are Armagh, Lurgan, Portadown, and Newry. Armagh is the county town. Pop. (1901) 125,238.

Armagh, a city of Ireland, capital of the county of Armagh. It contains two cathedrals, a Protestant and a Roman Catholic; county court-house, prison, infirmary, lunatic asylum, linen hall, music hall, a public library and an observatory. In the Middle Ages Armagh was an extensive and populous city, and celebrated for its learning, having at one period, according to Irish historians, 7,000 students at its college. It is the see of an archbishop of the Anglican Church, who is primate of all Ireland. Pop. (1901) 7,438.

Armagnac, är'ma-nyak', **Counts of,** an ancient French family, said to have sprung from a branch of the Merovingians. Many of its members hold a prominent place in the history of France. One of the most celebrated was Bernard VII., son of John II., surnamed the Hunchback. He succeeded his brother, John III., in 1391, and greatly extended his territories by the most unscrupulous means, putting several of his relations to death because they stood in the way of his ambitious schemes. Another of the family, John V., grandson of the above, who succeeded his father, John IV., in 1450, made himself notorious for his crimes. On a pretended dispensation from the Pope he married his own sister, by whom he had three children.

Ar'magnac', the title of a former district of France now included in the department of Gers. Its inhabitants figured largely in the wars of the Middle Ages, one of their contests being known as the “Armagnac War,” in which the Armagnac mercenaries of the Emperor Frederick III. were defeated by the Swiss, 26 Aug. 1444. See Berthault's ‘L'Armagnac’ (1899).

Armagnac War, The (*Bellum Armeniacum;* in German called frequently *Armegeckenkrieg*), the struggle between the Swiss and the Armagnac mercenaries of Frederick III. in 1444. The war was concluded by the defeat of the Armagnacs at Saint Jacob on the Birs 26 Aug. 1444. See Armagnacs, The.

Armagnacs, The, mercenary bands, derived chiefly from the district of Armagnac in southern France, and largely trained in the army recruited in 1410 by Count Bernard of Armagnac for his contest with the Duke of Burgundy. They made themselves extremely oppressive in France through their plundering; and when the Emperor Frederick III. requested auxiliary troops from Charles VII., to assist in the conquest of the Swiss, the latter gladly despatched the Armagnacs. Doubtless the king believed he might at the same time be able to

gain control of territory on the left bank of the Upper Rhine. What is known as the Armagnac war ensued. In Germany the word Armagnac was converted into *armer Geck* ("poor fool"), and the war frequently styled *Armegeckenkrieg.* One band of 20,000 Armagnacs proceeded by way of Lorraine, another of 30,000 to southern Alsace, whence it marched against the Swiss. At Saint Jacob on the Birs, 26 Aug. 1444, it was badly defeated, with a loss of 6,000, by 2,000 Swiss. It then retired to Alsace, and on 28 October a treaty (that of Ensisheim) was concluded between France and the Swiss Confederation. The Armagnacs continued for a time to work havoc in Alsace and Swabia, where the peasantry retaliated by condemning to death an Armagnac whenever they caught one. In 1445 the remnant was in part dismissed by Charles VII., in part incorporated with other companies of soldiery. Consult the article by Barthold in Raumer's 'Historisches Tascherbuch,' 2d series, Vol. III. (1842); Wülcker, 'Urkunden und Schreiber, Betreffend den Zug der Armagnaken' (1873).

Armançon, a river of France, in the Seine basin. It rises about 3 miles south of Pouilly-en-Auxois (Côte-d'Or), flows about 170 miles in a general northwesterly direction, and empties into the Yonne at La Roche. From Buffon it is followed by the Burgundian Canal. Its tributaries are the Brenne and the Armance.

Armament of the World. Arrangements made for defense with small arms and artillery belong to what is termed the armament. With small arms it is complete when the banquette and the interior and superior slopes are properly arranged to enable the soldier to deliver his fire with effect, and to mount on the parapet to meet the enemy with the bayonet. The armament with artillery is, in like manner, complete when suitable means are taken to allow the guns to fire over the parapet or through openings made in it, and when all the required accessories are provided for the service of the guns. The manner of placing artillery and its employment must be regulated by its relative importance, under given circumstances, with respect to the action of other arms. In the defensive, the principal part is usually assigned to the artillery; and the positions taken up by the other arms will, therefore, be subordinate to those of this arm. In offensive movements, the reverse generally obtains. Unless the batteries are on points which are inaccessible to the enemy's cavalry and infantry, they must be placed under the protection of the other troops, and be outflanked by them. Preparations should be made to receive the enemy on every point; the batteries must be distributed along the entire front of the position occupied, and on those points from which they can obtain a good sweep over the avenues of approach to it; the guns being masked, when the ground favors, from the enemy's view, until the proper moment arrives for opening their fire. Field artillery, used in the operations of an army in the field, must have the essential quality of mobility. The light pieces are constructed to follow the rapid movements of light troops and cavalry. The heavy pieces are employed to follow the movements of heavy troops, to commence an action at long distance, to defend field-works and important positions on the field of battle, etc. Field artillery is used in combination with infantry and cavalry, or with both to augment their fire and to weaken that of the enemy. It prepares the way for subsequent operations by its fire upon the enemy before he comes within reach of other weapons; it supports the movements of the various arms, and forms points of support and assembly for troops when driven back. The armament, small arms and field artillery, in the various countries, now used or, at this time, commended and undergoing experiment with a view to adoption, is set out in detail in this article.

Austria-Hungary.—The infantry is armed with the model 1895 repeating rifle. The technical troops, the field and foot artillery, and the enlisted personnel of the subsistence branches, carry the model repeating carbine (Repetier-Stutzen). The cavalry has the model 1895 repeating carbine (Repetier-Karabiner). All these arms are of the Mannlicher system and have a caliber of 8 millimeters. The Hungarian House of Representatives recently passed a law to arm the landsturm with 8 millimeter repeating rifles. The officers, cadets, and sergeants of the pioneers are armed with revolvers and are independent and capable of defending themselves. Experiments are now being made with the Roth automatic pistol with a view to its replacing the repeating revolver, model 1898, at present in use in the infantry. This pistol is provided with a hammerless firing mechanism and a breech closure composed of two rigid and symmetrical locking lugs and can receive 10 cartridges. The cavalry is partly armed with the model 1870–74 revolver, of the Gasser system, and partly with the model 1898 revolver transformed, this latter being adopted experimentally. Trials have taken place in Austria of machine guns for use with cavalry and for mountain warfare. The gun for the cavalry has a wheel mounting, drawn by a horse. In the mountain section the gun is carried by mules, one animal for the gun itself and two for the ammunition and mounting, and in action is used upon a tripod, variable in height and having a seat for the gunner upon the leg behind the breech. The mountain guns are upon the Maxim-Nordenfelt system, and fire the ordinary infantry cartridge with a rapidity of 500 rounds per minute, and sights graduated from 200 to 2,000 metres. The supply of ammunition carried with the two guns upon the mules provides for 11,000 rounds. Austria-Hungary is experimenting with new artillery material. The long recoil system has been adopted on principle, but the special model has not yet been decided upon. Some batteries of guns submitted by Ehrhardt and Skoda are at present in the hands of the troops. The type of the carriage and whether the caisson should be armored, are two questions now being carefully considered. The gun has been determined to be of 75 mm. caliber, with long recoil on the carriage, and is provided with shields and hinged portions and the interrupted-screw fermeture. With regard to the carriage, very complete and satisfactory tests have held with telescope-trail carriages of the Ehrhardt-Mannesmann system, and with carriages of the Skoda system. Both of the models have been modified and highly improved in the course of the experiments. It is believed that the Austrian War Department, adopting the idea that in battle the caissons will be under cover in rear of the line of pieces in battery, will

give up the idea of introducing armored caissons.

Belgium.—The infantry, technical troops, cavalry, and civil grades are armed with the 7.6-millimeter, model 1889, Mauser rifle. The noncommissioned officers and trumpeters of the mounted arms and the drivers of the field artillery have the Nagant revolver. The officers of the entire army and the noncommissioned officers, "brigadiers," and enlisted men of the gendarmerie carry the Browning automatic pistol. The field artillery consists of 34 regular and 6 reserve batteries, all with 6 guns. They are divided into field and horse artillery batteries. The field batteries, armed with 8.7-cm. guns, are attached to the army divisions; the gorse artillery batteries accompany the cavalry divisions and are armed with 7.5-cm. guns. The first and third field artillery regiments each consist of a staff of 8 regular and 1 reserve battery, plus another reserve battery for furnishing 3 ammunition columns and a depot. The second and fourth regiments each consist of a staff, 7 regular field and 2 regular horse artillery batteries; of 2 reserve field batteries, plus 1 reserve battery, for providing 3 artillery ammunition columns and a depot. Up to the present the Belgian field artillery has consisted of guns of the 1878 Krupp model of 2 calibers — one of 2.95-inch for the horse artillery, and one of 3.42 for the foot artillery. At the beginning of 1900 a committee was formed to decide on the best type for new guns, and as a result of the committee's deliberations a battery of guns of a new type was ordered from the John Cockerill Nordenfeldt Company, at Seraing, in order that the guns might be put to the test of actual use in the army. In these guns the barrel and carriage form, for the purpose of firing, one rigid piece; and this type of gun would probably have been selected for the Belgian artillery had not the new French gun prevented the committee from coming to a final decision. The principle of the French gun is the very opposite to the Cockerill gun, as in its case the barrel slides backward and forward on the carriage.

Brazil.—At the present time the troops carry the 7 millimeter, model 1893, Mauser rifle. Experiments are going forward with a view to partial rearmament, particularly with a view to the adoption of an automatic pistol. Competitive trials were held in 1902 between the Krupp and Creusot types, and according to Brazilian reports these tests have demonstrated the superiority of the German model. Further trials, however, of other types are in progress. Creusot, Krupp, Vickers, and Ehrhardt being in competition.

Bulgaria.—The infantry is armed with the 8-mm. Mannlicher rifle of the 1888 patterns. Each rifle is supplied with 200 cartridges, 100 being carried by the soldier, 50 in the regimental, and 50 in the artillery park transport. Officers and sergeant-majors are all armed with the Smith & Wesson revolver and a Russian-pattern sword. The militia are armed with Berdan rifles and have 80 cartridges per rifle. The cavalry is armed with the Mannlicher carbine and a Russian dragoon sword. Each carbine has 60 cartridges. The Parabellum automatic pistol, model 1903, is being substituted in place of the Smith & Wesson revolver, for officers. Bulgaria has taken no recent steps for rearmament of her artillery. The present field artillery has 8.7-cm. Krupp guns with 120 shots per gun. The reserve artillery has 75-mm. guns with 149 shots per gun, and 90-mm. bronze Russian guns. The mountain artillery has 75-mm. guns with 133 shots per gun. The gunners are being armed with carbines.

Chile.— Like Bolivia, Brazil, Colombia and Uruguay, the troops are armed with the 7-millimeter, model 1893, Mauser rifle; but experiments are now going forward with a view to partial rearmament. Chile seems content with its present field artillery material. This is a light field gun of the Krupp system, with elastic trail-spade, and is well adapted to the local conditions of the country.

Denmark.—The troops are armed with the 8-millimeter, model 1889, repeating rifle of the Krag-Jörgensen system. During the course of 1901 the Copenhagen militia was armed with 8-millimeter, model 1889, rifles, having hitherto had the models 1867–96 breech-loading rifles. A machine gun, invented by a Danish lieutenant and adopted in the Danish army and navy, has a caliber of 6.5 millimeters and a weight of 6 kilograms; the initial velocity is 720 meters. The rapidity of fire is attained by means of a loading frame holding 30 cartridges, which can be fired in two seconds. The rate of fire is thus 300 rounds per minute, including the time required to substitute full loading frames for the empty ones. Experiments of new field guns have been completed, and the firm of Krupp has been commissioned to deliver the new material, excepting the ammunition. The gun is 75 mm. caliber, on the "Rohrrucklauf" carriage, with shield. The weight of the projectile is 6.75 kgs.; initial velocity, 500 meters per second. Rapidity of fire, 15 to 20 shots a minute. Weight of carriage is 1,000 kgs. Weight of gun, including ammunition and limber (44 rounds), 1,800 kgs. The ammunition carts are armored.

France.—The troops are armed with the 8-millimeter, models 1886 and 1893, rifles and carbines. At the normal firing school of the fortified camp of Chalons-sur-Marne experiments were made in the summer of 1902 for the purpose of improving the firearms of the infantry. The object was to do away with the exceedingly sensitive repeating mechanism and to substitute for it a loader which, without impairing the rapidity of fire, would preclude any possibility of the weapons being rendered unserviceable. The latest invention, which is said to have attained good results, is a new projectile called "bullet D." Very satisfactory experiments were carried out with this bullet. Preparations are being made for the manufacture of 30,000 carbines of a new model for the colonial army. It is intended to substitute this new weapon for the models 1886–93 rifles and the model 1892 carbine in the colonial infantry and artillery. The rifle has proved too heavy and cumbersome for the difficult and fatiguing service which these troops have to perform on their extensive expeditions. The old carbine has not shown itself equal to requirements. Not to mention its heavy recoil, in certain cases it does not produce sufficient intensity of fire and therefore does not inflict as heavy losses on the enemy as are necessary. It has, therefore, been decided to adopt a mixed model in which the ballistic qualities of the Lebel rifle and the present cartridge are retained but a different repeating mechanism is used. The experiments with au-

tomatic rifles are being continued uninterruptedly in France. In the spring of 1902 experiments were made with the Mondragon automatic rifle and carbine on the firing grounds of Hotchkiss & Co., at St. Denis, and gave complete satisfaction and proved the superiority of the weapon over all others tested theretofore.

However much opinions may differ regarding the military utility of automatic rifles, there is certainly a manifest tendency toward increasing the rapidity of fire of small arms to correspond with the improvements that have recently been made in rapid-fire cannon. The automatic rifle bids fair to become the weapon of the future. Germany and Italy already have a model which is by no means inferior to the Mondragon rifle as a military weapon. These models, however, are being carefully preserved in arm depots. The authorities are ready to begin their manufacture and to arm the troops with them as soon as France has set the example. Most foreign officers have acknowledged the superiority of the automatic rifle, but its adoption is being indefinitely deferred because it would entail an enormous burden on the military budgets of the European countries.

The French field batteries have been armed with the new 75 mm. rapid-fire material since 1897. This is a long recoil field gun with protective shields and was manufactured with great secrecy in the government work shops at Brouges. Although the secret of the details of construction is not divulged, it is nevertheless known that this gun possesses great ballistic power, and that its projectiles weigh somewhat more than those of similar guns constructed elsewhere. Its only disadvantage appears to be the weight of gun and carriage. Criticism has also been made of the shields used, as presenting rather a reduced amount of surface for the protection of the cannoneers. The pneumatic recuperator is about to be given up for a light rapid-fire gun suitable for the horse artillery.

Germany.— The marine infantry, the infantry regiments of the East Asiatic brigade of occupation, the guard corps, and parts of the first to seventh, ninth, eleventh, twelfth, fourteenth, and eighteenth army corps, and of the noncommissioned officers' schools are armed with the model 1898 rifle. The issue of the model 1898 carbine has been begun. A new weapon (a sort of carbine) will be purchased for the foot artillery after the rearmament of the infantry is completed. All the remaining organizations of the German army now carry the model 1888 rifle or carbine. The small-arms and ammunition factory of Adolph Loesche at Magdeburg, has placed a target rifle on the market which is in use in several infantry regiments with great success. Three kinds of cartridges are adapted to this rifle. Experiments are now in progress with the Borchardt, Mauser, Mannlicher, Parabellum and Browning automatic pistols.

Germany is now inclining to the new long recoil system in artillery. Although the minister of war maintains his opinion before the reichstag of the superiority of the German elastic trail-spade type over the French long recoil, Germany, nevertheless, continues the process of transformation or suppression of the model 1896. The necessity for rearmament is appreciated and desired, but such haste was made in adopting the model 1896 material with elastic trail-spade that financial considerations prevent Germany from undertaking at present a completely new rearmament of the field artillery. The result is that trials are now going on to change the field guns, model 1896, into long recoil guns by an adaptation of recoil on the carriage to the present gun, that is to say, while keeping the gun itself, a carriage has been designed with a cradle for the piece. The carriage has also been fitted with protective shields. The guns thus modified do not possess the double-laying arrangement applied to the cradle or top carriage. The gun itself retains the rear sight and fore sight, and the changes that have been made affect principally the carriage. According to the German press, the results have been satisfactory both in regard to acting during firing and in maneuvering facilities. In spite of the added weight of the shields, the total weight does not exceed the usual limits. Thirty-six of these altered guns are in the hands of troops, attached in part to the guard at Berlin, three batteries, and in part to the Field Artillery Shooting School at Juterbog. Five batteries have taken part in last autumn's maneuvers and have given satisfaction. In addition to the foregoing, Germany is also engaged in conducting trials of new long recoil types. The Ehrhardt new model, 1899, has been found inadequate and Krupp's model, 1900, has proved better. Two of these guns were tested in 1902 by an artillery commission and resulted in orders being given for seven trial batteries, which were thoroughly proved under service conditions in 1903, and were found to be very satisfactory, but the design was modified slightly and submitted for further test. The Krupp gun chosen is similar in all particulars to that adopted by the Swiss, and like that model constitutes one of the best of the recently constructed rapid-fire systems.

Great Britain.—The European and the greatest part of the Indian native troops carry the 7.7-millimeter Lee-Metford rifle, model 1889–91, and the models 1895 Lee-Enfield rifle; the remainder of the Indian native troops are still armed with various old models, among which are the Martini-Henry and Snider rifles, while certain select corps and the military police on the northwest frontier carry Mauser rifles captured in South Africa. The unmounted officers of the foot troops carry the Lee-Enfield carbine, while the other officers are armed with the revolver. The contemplated improvements in the Lee-Enfield rifle shown to be necessary in the South African war appear to be essentially as follows: The barrel will be shortened by 127 millimeters and will thus be the shortest barrel possessed by any rifle yet adopted. In order to compensate for the decreased stability of the projectile caused by this shortening of the barrel, the seven rifling grooves are to be given a somewhat higher pitch, so that the trajectory will remain similar to the previous one. The Mauser breech-closing mechanism has been adopted, with some improvements enabling it to be taken apart without the use of a screw-driver. It will be fed by means of a loading clip containing five cartridges. The sight has been improved and provides for an allowance for wind and temperature. A triangular dagger bayonet 35 centimeters long and slightly heavier than the present one has been adopted. In order to

lighten the weapon holes are bored longitudinally through the handguard and transversely through the stock, the butt plate being of aluminum. The total reduction of weight amounts to .530 kilogram, leaving the weight of the rifle 4.12 kilograms. Experiments with the Ross straight-pull breech closure, the Harris magazine, and the Hylard rifle do not appear to have resulted favorably. Canada has, however, decided to adopt the Ross rifle, and both rifle and ammunition are to be manufactured in the government factory at Quebec, the number of rifles to be turned out yearly being from 12,000 to 15,000. The length of the Ross rifle without bayonet is 1.22 meters, and with bayonet 1.44 meters; the weight without bayonet is 3.43 kilograms; with bayonet 3.74 kilograms. The Australian colonies appear to have decided to adopt the Ross rifle. Major Woodgate, of the British army, has recently invented a new system of automatic rifle, which is very simple and capable of adjustment to rifles already in service, including the Lee-Enfield. The chamber of this rifle has a capacity for 20 cartridges (10 being the normal number), so that the number of rounds per minute can be brought up to 200.

In artillery England has 18 batteries of Ehrhardt rapid-fire guns, of 3-inch caliber, firing a projectile weighing 14 pounds 15 ounces. The carriage has a hydraulic buffer with spring recuperators for returning the piece in battery, and a telescopic trail. After several years of experiment, a long recoil gun, combining the best qualities of recent designs by Armstrong and Vickers, and much superior to the former 15-pounder, has been adopted. The new gun is exceptionally powerful and efficient. The improved time fuse permits of effective shrapnel fire at a range of 6,000 yards, an enormous advance on anything possible with the old type of field gun. There are four special points in which the new type surpasses the old. These are simplicity of the breech action, in which the interrupted screw is abolished, increased range, vastly increased rapidity of fire, and perfect absorption of the recoil. In the old type of gun a coned steel block carrying an interrupted screw thread was used to close the breech, and intricate and comparatively delicate mechanism was necessary to work it quickly, while the danger of barring or injuring the screw threads when inserting the shell necessitated an amount of care which materially interfered with the loading of the gun.

Greece.—The infantry is armed with the 11-millimeter, model 1871, Gras rifle; but experiments are in progress to decide upon a rearmament with a small caliber rifle. For financial reasons, Greece has not made any decision as regards the rearmament of field artillery.

Italy.—All the infantry of the line and the mobile militia are armed with the model 1891 rifle, the cavalry with the model 1891 carbine, and the special arms with the model 1891 carbine (Stutzen), all of the 6.5 millimeter caliber. The territorial militia carries the modified Vetterli rifle, caliber 10.4 millimeters. A new pistol, embodying all the latest improvements, has been adopted for the officers of the army in place of the 10.35-millimeter, model 1889, revolver. It has an automatic mechanism, is of small caliber, and fires smokeless powder. The loading is done in the same manner as the model 1891 rifle. The field gun question in Italy has long been a subject of controversy. Discussion of the question of the proper type of new material has been vigorously conducted on both sides by critics and leading military writers, but the Italian army, it seems, is the one that has remained for the longest time averse to the idea of a field gun with long recoil on the carriage. As is known, the Italian field artillery consisted of two calibers of guns, the 87 mm. B, of steel, forming the armament of the larger part of the batteries, and the 75 mm. B, of bronze. In 1896 and 1897 when France and Germany effected the transformation of their field material a partial transformation was decided upon in Italy. For the material 87 mm. B, the cast-iron shrapnel was retained, and the changes made were confined to limiting the recoil of the piece by the addition of a trail-spade, and to increasing the rapidity of loading by improvements in the breech mechanism.

Japan.—All the infantry is armed with the 6.5 millimeter 30 Meiji rifle, and the cavalry with the Meiji carbine. The weight of projectile of the new rifle is 10.3 grams, and the velocity of the bullet at 25 meters from the muzzle is 706 meters. The Mourata guns of the 1880 and 1887 types arm the troops of the second line. The new gun of Col. Arisaka, model 1897, manufactured at the Tokio works, like the Russian gun, is a repeater of small calibre (.25 inch) with a central magazine for five cartridges. It belongs to the Mauser type. The barrel is 31 inches in length and is provided with six grooves turning from left to right. The breech sight is mounted upon it by means of a long sleeve, the upper part of which, flattened and hollowed, forms its foot. The prismatic muzzle-sight is secured to a small hoop surrounding the barrel. The movable breech is of the bolt system, and turns back upon the side. The magazine, closed at its lower part by a cover, contains an elevating plate actuated by a spring. The recharging is done by means of a brass charging plate provided with five cartridges. The breech sight, without steps, is graduated from 400 to 2,000 yards. A sabre-bayonet having a 21-inch blade, with bevelled and hollowed sides, is attached in the usual manner. The cartridge weighs 336 grains. The initial velocity is 2,378 feet and the pitch of the trajectory is 387 feet at 500 yards. The gun, with the bayonet, is 5.44 feet and weighs 9.6 pounds. The Japanese foot soldier carries 120 cartridges, partly in two cartridge boxes and partly in boxes in the knapsack. Japan seems very well satisfied with their Arisaka gun for artillery use, and nothing has appeared of any steps being taken towards the introduction of a new material.

Mexico.—The infantry is armed with the 7-millimeter, model 1893, Mauser rifle, and the cavalry with the 7-millimeter Mauser carbine. There are probably about 10,000 modified Remington rifles (arranged for Mauser ammunition) and 15,000 Remington rifles of larger caliber on hand. It is doubtful whether the rifle, which was first manufactured in the French rifle-factory at Saint Etienne, really possesses the qualities attributed to it, namely, absolute reliability, accuracy, and a rate of fire of 60 rounds per minute when used automatically. According to trustworthy reports a rate of fire of 13 to 15 shots per minute was attained during ex-

periments made in Mexico with the Mondragon rifle used as a repeater in aimed fire; in filling the magazine the marksman had to place the rifle against his thigh, probably in order to overcome a strong resistance of the lock mechanism. When used as an automatic arm a rate of 31 shots per minute was attained only once, which resulted in injuring the breech mechanism. The latter is said to get out of order very easily, and, moreover, the muzzle jumps at every shot, so that the accuracy cannot be very great during automatic rapid fire. In artillery Mexico has carried out long competitive trials and at their conclusion, after having ordered four batteries of guns from Creusot in 1902, asked Saint Chamond in 1903 to submit a model of the Saint Chamond-Mondragon type modified according to the desires of the Mexican commission. If this type proves satisfactory, eight batteries are to be ordered at once.

Montenegro.—This principality has 30,000 Russian three-line repeating rifles and 80,000 rifles of various other systems, principally Berdan and Werndl rifles. The enlisted men of the first seniority are armed in peace with one new and one old rifle each. The field artillery consists of the Krupp steel gun, caliber 75 mm.

Netherlands.—All troops are armed with the 6.5-millimeter, model 1895, Mannlicher rifle and the 9.4-millimeter, model 1873, revolver, Chamelot-Deloigne system. The 6.5-millimeter rifle fires a bullet weighing 10.15 grams with an initial velocity of 723 meters. The present field artillery dates from 1878, and no longer fulfills the ballistic and other technical requirements of the present day. The necessity of rearmament was taken under consideration in 1901 and models were entered by Ehrhardt, Schneider-le-Creusot and Krupp. It has been determined that Krupp's 75 mm. long recoil gun deserved the preference and the same has been recently recommended for adoption and a contract for 204 field guns of this type is now pending. The adopted type is the Krupp nickel-steel field gun with long recoil on the carriage; its length is 30 calibers, and it is provided with nickel-steel shields 3 to 4 mm. thick. It fires shrapnel and explosive shell weighing 13.2 pounds, fixed ammunition being used. The muzzle velocity is 1,640 f. s., rapidity of fire 20 shots per minute. The shrapnel contains 270 bullets, each weighing 11 grams. The extreme range is 7,000 yards, and that for shrapnel with time fuse 6,125 yards. The unlimbered gun weighs with shields and complete equipment not quite 2,200 pounds. Each gun with its limber and 3 caissons counts 336 rounds. The introduction of this material will be completed by the end of 1906.

Norway.—The infantry is armed with the 6.5-millimeter, model 1894, Krag-Jörgensen rifle, which fires the model 1896 cartridge. Experiments, concluding in 1891, were made with models of long recoil guns from Armstrong, Hotchkiss, Nordenfelt-Cockerill, Saint Chamond, Schneider-le-Creusot, and Ehrhardt, and finally gave preference to the last named. The program of the tests was very thorough and severe. It included firing 350 rounds from each gun, transportation over long distances both by rail and in ordinary carts over mountainous country, in which the material received much rough treatment, more firing tests and finally a long march over difficult country and under varied conditions. The final firing showed that the material was in good condition, all the parts functioned well, and the hydro-pneumatic brake was in perfect order. Norway has obtained 132 guns of the Ehrhardt system and 72 caissons. As in the case of France, the adopted gun has the disadvantage of being rather heavy, 2,209 pounds, without any shields. The question of shields has only been considered after the guns were ordered, so that its weight makes the problem of providing it with shields a difficult one.

Portugal.—The infantry of the active army and of the first reserve is armed with the 6.5-millimeter, Mannlicher rifle; the infantry of the second reserve is armed with the 8-millimeter, model 1886 Kropatschek rifle; and the colonial infantry and artillery and the cavalry carry the 6.5-millimeter Mannlicher carbine. The only modern field artillery Portugal possesses are two horse batteries having guns with elastic trail-spade carriages. The government sent a special commission some time ago to different countries to gather information from the prominent gunmakers. This commission has submitted its report, on the strength of which it has been decided to make conclusive trials in Portugal with some proposed constructions by Krupp and Schneider.

Russia.—The active and reserve troops are armed with the three-line rifle (7.62 millimeters), model 1891, and the cavalry with the 7.62-millimeter, model 1896, Cossack carbine. The 7.62-millimeter Nagant six-shooter, non-gas-leaking revolver has been officially adopted and is manufactured in the Belgian arm-factory by Leon Nagant at Lüttich. The extensive small arm factories in Russia are those of Tula, Sestrorietsk, and Ijevsk. They not only manufacture rifles, but all other kinds of war stores. The 3-line (.275-inch) gun of the 1891 model is the invention of Col. Mossine of the Russian artillery and is a repeating arm with a central magazine for five cartridges. The barrel has four grooves directed from left to right and is 30 inches in length. The breech box, screwed to the rear of the barrel, is provided on the side to the left with a piece that acts as cartridge shell ejector and isolator. The movable breech is of the bolt type and swings back at the side. The magazine contains the elevating mechanism, formed of a lever joined to the cover and a plate jointed to the lever. It receives a loader provided with five cartridges. The breech sight is stepped and provided with a slider, which is held in place by a spring and serves for indicating distances. The bayonet comprises a quadrangular blade and remains fixed to the end of the barrel, even during firing. The cartridge weighs 590 grains. The initial velocity is 2,035 feet and the pitch of the trajectory at 1,970 feet is 72 feet. The length of the gun with bayonet is 5.7 feet and weighs 9.5 pounds. The Russian soldier carries 120 cartridges, partly in two cartridge boxes and partly in the knapsack. After protracted experiments Russia has provisionally chosen for the field artillery a type of gun and carriage designed by General Engelhart. A large part of the Russian field artillery has been armed with this new gun constructed at the Poutilov works. The gun, together with the cradle that supports it, recoils on the lower carriage, and the recoil is controlled by a glycerine brake, and a column

of rubber buffers fitted in the trail. These rubber cushions act as return springs to return the gun in battery. This gun is of great ballistic power, but the same objection is raised against it as in the case of the French and Norwegian material, its great weight. Nor is the carriage provided with shields. Whether the caissons are to be armored is not known, though the regulations prescribe placing them beside the pieces in action.

Servia.—The infantry carries the 7-millimeter, model 1899, Mauser rifle, and million rounds of ammunition for this rifle has been purchased. The engineers, fortress artillery, and militia have a reserve of Berdan and Peabody rifles. The cavalry carry Mauser-Kota carbines and swords. The artillery is armed with 80 mm. de Bange guns, and has, in addition, 60 Krupp and 40 mountain guns. The gunners are armed with the same rifle as the infantry. The siege artillery has 90 guns of six different types, and in the fortress artillery the difference of the systems is even more marked. Up to the present time, the trials contemplated in Servia have been only with a battery of Skoda guns. They were being begun at the time of the assassination of King Alexander. Additional trials are now contemplated.

Spain.—The Spanish army is armed with the 7-millimeter Mauser rifle. In artillery Spain after prolonged trials ordered three years ago from Saint Chamond and from Krupp 120 guns of a transition type. The carriages are equipped with hydraulic brakes, have a trail-spade, and there are spring recuperators under the body of the carriage. This material was delivered about two years ago. At about the same time 24 field pieces with long recoil on the carriage were ordered from Creusot, which were accepted only after much delay due to the failure of the material to meet the requirements of the Spanish artillery. Recently the Spanish government opened a new competition for guns with long recoil on the carriage, but it seems that no decision has been arrived at as to the type to be adopted for the field artillery. It is reported that the idea of experimenting at home has been given up, and a special board of information has been sent to France, England and Germany.

Sweden.—The infantry is armed with the 6.5 millimeter, model 1896, rifle, and the cavalry with the model 1896 carbine, both of the Mauser system. In order to replenish the supply, 350,000 rifles and 50,000 carbines of the above-mentioned models are to be purchased for the Swedish army. When recent artillery trials began in Sweden, Cockerill and Krupp were the only competitors. The two French firms, Schneider and Saint Chamond, found it impossible to fill the specifications as to the weight of the unlimbered gun. The Krupp long recoil material was adopted for the field artillery, and Sweden has ordered 132 guns and 66 caissons from Essen. For the horse artillery the Krupp short recoil material was chosen, and 24 guns with elastic trail-spade have been bought from the Krupp works.

Switzerland.—The infantry has the 7.5-millimeter, model 1889–96, Schmidt-Rubin rifle; the cavalry carries the 7.5-millimeter, model 1893, rifle, with Mannlicher breech closure; the position artillery, fortress troops, telegraph companies, balloon company, and cyclist detachment are armed with the 7.5 millimeter, model 1889–1900, short rifle; the cadets have the 7.5-millimeter, model 1897, cadet rifle; the officers carry the 7.65-millimeter, model 1900, pistol; the noncommissioned officers and buglers of the élite cavalry and artillery are provided with model 1882 revolvers; the remainder have the model 1878 revolvers. A spirited controversy has arisen in regard to the qualities of the recently adopted model 1900 automatic pistol (Parabellum). The arguments advanced are specially worthy of interest as affording an idea of how the Parabellum pistol behaves in actual service, Switzerland and Belgium being the only countries that have thus far adopted an automatic pistol to any great extent. The general impression gained is that in changing from a revolver to a pistol the troops did not perhaps receive adequate instructions as to the management of the latter, so that a number of accidents occurred which were rather due to the ignorance of the possessors regarding the weapon than to any inherent defect in the weapon itself. From a circular issued by the chief of artillery forbidding the making of any changes in the pistol by private armorers it appears probable that the accidents which have occurred are attributed to such changes. In the recent Swiss trials of artillery nearly all the leading gun factories of Europe competed and Cockerill, Ehrhardt, Krupp, Schneider and Skoda furnished their latest models. Saint Chamond accepted the invitation to compete, but did not deliver its gun in time and did not participate in the trials. Later on this gun was inspected at Saint Chamond but without result. In fact, the artillery commission on field artillery rearmament has during the last six years submitted all the models that it has been able to procure and experiment with, to most searching examination and most thorough tests under all conditions. The final trials commenced in 1901, and in March 1903 the commission submitted its report declaring that the Krupp 75 mm. long recoil model was not only the most satisfactory in all respects and the best of all the models tested, but that it was the best adapted for service in the field. The Federal Council addressed a message to the Federal Assembly on 1 May 1903, deciding on the adoption of the new gun, and in that year the Swiss government ordered from Krupp 288 guns, with which it is proposed to arm 72 batteries of 4 pieces each. This does not include reserve material and that for instruction purposes. The material adopted, officially designated "field artillery material, 1903," is Krupp's latest design of long recoil field gun with spring recuperator and shields. The question of the exact dimensions of the shield is deferred for the time being; the size may be reduced and the side wings dispensed with. It was decided by the commission to armor the caisson bodies. Fixed ammunition is used. The larger part will consist of shrapnel with combination fuses, that being considered the principal projectile, but the batteries will also be provided with explosive shell with percussion fuses. All projectiles will have the same weight. The ammunition supply will be 800 rounds per gun. The commission also studied the question of field howitzers, making trials of different models submitted by Krupp and Skoda, and decided in favor of one of 12 cm. caliber, but the particular

model is still to be selected. The commission was of the opinion that the introduction of a howitzer for the Swiss artillery should not be made at the price of reducing the number of field guns. It estimated that there was necessity for the purchase of 8 batteries of 4 pieces each, constituting 4 groups of 2 batteries. For the howitzers, the ammunition supply will be 500 rounds per gun. In regard to mountain guns, the commission has conducted several tests of a Krupp gun of a system similar to that of the field material, 1903. Although the results obtained thus far have been satisfactory, it has been thought best to continue the experiments with two pieces in which certain modifications of details have been made.

Turkey.—The cadres of the European army corps (first, second, and third) are armed with the 7.65-millimeter Mauser rifle, the fourth corps (Asia Minor) has the 9.5-millimeter Mauser magazine rifle, and the troops of the other corps carry the 11.4-millimeter Martini-Henry and Peabody rifle. The manufacture of the 7.65-millimeter Mauser rifles in Turkish shops has encountered difficulties, for, according to authentic reports, 200,000 rifles of caliber 7.5 mm. were ordered in Germany at the end of 1902. The Turkish field artillery consists of 248 batteries, of which 18 are field, 178 horse, 46 mountain, and 6 howitzer batteries. It is said that 9 more batteries are in course of formation. Without having any recent trials at home, Turkey has ordered from the Krupp works 184 guns with which it is intended to equip 16 batteries of 6 pieces each, and 22 batteries of 4 pieces. These guns are of the modern long recoil system. The order included all accessories, caissons, battery wagons, ammunition and harness. The government is now urging the delivery of the first six batteries constructed. Turkey has in the past sent several delegations to Essen and on two occasions also to other workshops. A military commission of prominent officers of the sultan's army is now in France visiting the establishments of Creusot and Saint Chamond in order to study the most recent models of long recoil rapid-fire guns.

United States.—The new Springfield magazine rifle, possessing numerous improvements on the Krag-Jorgensen rifle, is now under construction and will be placed in the hands of all troops, regular army and National Guard, as rapidly as possible. The principal points of its difference from the Krag-Jorgensen are the use of two lugs instead of one for holding the bolt against the rearward pressure of the powder, with resulting increase of strength sufficient to enable a velocity of 2,300 feet per second to be obtained; the housing of the magazine in the stock directly below the chamber instead of having its project to one side. In addition to these there are various changes of details which both improve the rifle and cheapen and accelerate its production. The arm is supplied with a cleaning rod which can be partially pulled from its place below the barrel and held with a catch so as to form a bayonet. Its great advantage is that it lightens the weight made up of the gun, bayonet, and bayonet scabbard, and by dispensing with the latter two as separate articles to be carried permits the soldier to carry with him an intrenching tool of sufficient size and weight to be serviceable. There are differences of opinion as to the value of the rod bayonet; although less effective as a bayonet alone than the one now in use in the service, it is undoubtedly of some value in converting the musket into a pike, and in view of the increasing prominence of the intrenching tool and the decreasing occasion for the use of the bayonet its experimental substitution is in line with apparent progress in subordinating the latter to the former. The piece is centrally fed by means of clips, each of which holds five cartridges. It has a caliber of .30 inch, and the rifling is made up of four grooves of a depth of 0.004 inch, the twist being one turn in 10 inches. The bullet weighs 220 grains, which is the same as that of the Krag-Jorgensen, but the powder charge has been raised from 37.6 to 43.3 grains. In spite of the considerable increase in its power the weapon has been greatly reduced in weight; for while the Krag-Jorgensen rifle weighs 10.64 pounds, the Mauser 10.5 pounds, and the German military rifle 11.54 pounds, the new weapon weighs only 9.47 pounds. It follows, as a matter of course, that, with such high velocity and fairly heavy bullet, the trajectory is correspondingly flat, the maximum ordinate of the 1,000-yard trajectory being only 20.67 feet as against 25.8 feet for the Krag-Jorgensen gun, a very material difference. The cartridge for the .30 caliber arm consists of the case, bullet, primer and charge of smokeless powder. The case has a flanged head, primer seat, conical body, shoulder, cylindrical neck, and is made of brass. The bullet is lubricated, and has a core of lead and tin composition jacketed with cupro-nickel; it has three grooves, and the mouth of the case is crimped into the front groove to secure the bullet in place. The core is composed of 1 part of tin and 25 parts of lead by weight; this proportion is varied slightly in order to keep the weight of the finished bullet constantly at 220 grains. The primer is composed of a cup, made of cartridge copper and containing the composition, a water-proofed paper disk, and a brass anvil. In plan, the anvil is a circle with two small semicircular portions removed from opposite sides; these two openings form vents for the passage of the flame from the composition to the powder. The powder is of the nitroglycerine type. Up to the present time three different powders have been used (Peyton, Du Pont and Laflin & Rand, W. A.). The charge varies with the powder used from 35 to 42 grains. The primer composition is known as H-48, and consists of 8.63 per cent sulphur, 25.12 per cent antimony sulphide, 49.61 per cent potassium chlorate, and 16.64 per cent glass crystals. The weight of the cartridge complete varies from 435 to 442 grains. The standard instrumental velocity, at 53 feet from the muzzle, of this ammunition in the rifle, is 1,960 feet per second, with an allowed variation of but 15 feet per second on either side of the standard. This instrumental velocity at 53 feet corresponds to a muzzle velocity in the rifle of about 2,000 feet per second. The velocity in the carbine is 80 feet per second less than in the rifle. Experiments with automatic pistols and their trial in the hands of troops are in progress, but the conflicting reports of the advantages and disadvantages of the weapons issued for trial have not been such as to warrant the abandonment of the present service revolver for any of the types tried.

Work upon the lately adopted 3-inch field artillery material is progressing rapidly. There are under construction 25 batteries for the regular service and 16 for the militia. The caisson for the material differs from that in use with the 3.2 inch B. L. rifle in being a metal fabrication, and in having a single chest, instead of two, upon the caisson body, and the omission of means for carrying spare wheels, these latter being transported on the combined forge and battery wagon. The manufacture of 90 mountain guns, carriages and pack outfits of the Vickers Sons & Maxim system, with several suggested improvements, is in progress. The aparejo to be used is a modification of the former regulation pattern, with a view to facilitating packing and general adaptability. Experiments and investigations are now active with a view to bettering the mountain, field, and siege artillery, and machine and automatic guns, of which the famous Gatling is the pioneer. The models in use at the present time are the 1.456-inch (37-millimeter, 1-pounder) automatic gun, 1.50-inch revolving cannon, 1.65-inch B. L. mountain gun, 2.95-inch Vickers-Maxim mountain gun, 3-inch Hotchkiss mountain gun, 3.2-inch B. L. rifle, 3.6-inch B. L. rifle, 3.6-inch B. L. mortar, 5-inch B. L. siege rifle, 7-inch B. L. howitzer, and 7-inch B. L. mortar, together with a variety of pieces used for saluting purposes and for firing the morning and evening guns at posts. These latter are nearly all of the old 3-inch, wrought-iron type, or 12-pounder bronze smooth-bores.

Sea Coast Artillery.—It is only recently that we have become accustomed to the term "Sea Coast Artillery." A few years ago all guns were comparatively small, using the same propelling agent and firing spherical projectiles. Not long ago, any siege gun would have been serviceable against the wooden ships of the day. To-day, all countries have sea coast guns to resist naval attacks and siege guns for the reduction of fortified positions. It is not improbable that the United States may be soon called upon to use sea coast guns, while it is difficult to imagine circumstances under which we might employ our siege artillery. In Europe — that is, on the continent — sea coast artillery is unimportant; for there, war consists practically of land fighting and consequently the field artillery comes prominently forward. France and other countries have a mongrel lot of obsolescent guns in their shore defences, while they have recently spent millions of dollars for rapid-fire field pieces of the latest designs. Twenty-five years ago the propelling agent was black powder; and, in loading, the powder charge, the projectile and the primer were separately put in place. Now these are in one piece, smokeless powder is used, and great improvements in the breech mechanism have wonderfully increased the rate of aimed fire. The control of the recoil and the universal use of shrapnel is a great step toward the possibility of disabling an antagonist before he can fire a shot in return.

The rapid fire and sea coast guns of the United States, at present in use, many of which are almost obsolete, are the 6-pounder American Ordnance Company gun, the 6-pounder Driggs-Seabury gun, the 15-pounder gun, the 4-inch Driggs-Seabury gun, the 4.72-inch Armstrong gun, the 6-inch Armstrong gun, the 5-inch Ordnance Department gun, the 6-inch Ordnance Department model 1897 gun, the 6-inch Ordnance Department model 1900 gun, the 8-inch B. L. R. gun, the 10-inch B. L. R. gun, the 12-inch B. L. R. gun, the 12-inch B. L. M., cast-iron body gun, and the 12-inch B. L. M. steel gun. These guns, together with several experimental, including the 10- and 6-inch Brown segmental tube wire guns, the 6-inch wire-wound gun (Ordnance Department design), and a 6-inch Bofors R. F. gun with semi-automatic breech action constituting our coast armament of to-day, are far from satisfactory and invite the development and substitution of new features. The 16-inch gun, called for by the Fortification Board in 1885, has been recently constructed. As no gun of this power has heretofore been built, and as a special powder had to be made for it, the test was watched with much interest. It was designed to fire a 2,400-pound projectile with a muzzle velocity of 2,300 feet per second and a powder pressure not exceeding 38,000 pounds per square inch. The proof firing was attended with entire success. At the fourth round with a charge of 640 pounds of Du Pont's smokeless powder and a 2,400-pound projectile, a velocity of 2,317 feet per second with a pressure of 36,700 pounds per square inch was attained. That the design and construction of such a huge weapon should be successfully accomplished without a mishap of any kind, and that the calculated ballistic results should be so accurately verified, are subjects of gratification. The use of smokeless powder in such large charges was beyond the experience of the world, and the demonstration that it would when so used follow the same law of burning as with charges of the size previously employed is a service to the art of the construction of ordnance. Whether this gun will be reproduced for use in sea coast fortifications is a matter still to be determined; there are at present no plans calling for its installation, but it is satisfactory to know from the results of actual trial that, in considering at any time the desirability of employing guns of greater power than those of the caliber, 12 inches, now constituting our most powerful weapons, the subject need not be complicated by the question of practicability.

CAPT. EDWARD S. FARROW,
Late Assistant Instructor of Tactics at the United States Military Academy.

Armand, är'mäñ, **Charles Teffin**, a French soldier: b. in 1753; d. in 1793. Coming to America in 1777, he was given a colonel's commission in the American army, succeeded Pulaski in command of the "Pulaski Legion," in 1779, and became a brigadier-general in 1783. Returning to France he was active on the Royalist side in the French Revolution.

Armande, är-mänd', an elder sister of Henriette in Molière's 'Les Femmes Savantes.'

Armansperg, är'mans-perg, **Joseph Ludwig, Count von**, a Bavarian statesman: b. in 1787; d. in 1853. He was president of the regency of Greece, 1833–5, and chancellor of state, 1835–7.

Armatoles, är'mä-tōlz, bodies of Greek militia inhabiting districts in the mountains of Greece assigned to a *capitani* for protection before Greece became independent of Turkey. To

these fastnesses fled the independent part of the Greeks, in order to continue the war under leaders called *capitanis*. A capitani collected generally a troop of from 50 to 200 men, who remained true to him through every variety of fortune, and attacked the enemy everywhere. Thus involved in an endless struggle with their oppressors, these Greeks were apt to degenerate and become little better than bandits. A large number of them were careful to confine their depredations to Mussulmans; but many instances occurred in which Greeks were attacked when the booty expected was considerable. The Turkish pashas, unable to subdue the armatoles, generally treated with them; and the capitanis received, on condition of remaining quiet, money, stores, or other perquisites.

Ar'mature, a term applied to the piece of soft iron placed across the poles of permanent or electro-magnets to receive and concentrate the attractive force. In the case of permanent magnets it is also important for preserving their magnetism when not in use, and hence it is sometimes termed the keeper. It produces this effect in virtue of the well-known law of induction, by which the armature, when placed near or across the poles of the magnet, is itself converted into a temporary magnet with reversed poles, and these, reacting upon the permanent magnet, keeps its particles in a state of constant magnetic tension, or, in other words, in that constrained position supposed to constitute magnetism. A horse-shoe magnet should therefore never be laid aside without its armature; and in the case of straight bar-magnets, two should be placed parallel to each other, with poles reversed, and a keeper or armature across them at both ends. The term armature is also applied to the core and coil of the electro-magnet, which revolves before the poles of the permanent magnet in the magneto-electric machine, and to a part of the telegraph sounder.

Armed Neutral'ity, a term denoting the condition of affairs when a nation not only assumes a threatening position, but maintains an armed force to repel any aggression on the part of belligerent nations between which it is neutral. The term is applied in history to a coalition entered into by the northern powers in 1780 and again in 1800.

Armed Sol'dier of Democracy, a term occasionally applied to Napoleon Bonaparte because of his supposed expression of the ideals following the French Revolution.

Armenia, är-mē'nĭ-a, a mountainous region of western Asia with an area of about 120,000 square miles. It is now partitioned among Turkey, Persia, and Russia.

The plateau of which Armenia chiefly consists is mountainous and volcanic. The ridges, of which there are four principal, are generally parallel to each other, running, with sundry deviations, east and west, and between them are broad valleys and plateaux; that of the Aras, at Mount Ararat, being 2,890 feet, and many others 5,000 to 8,000 feet above the sea-level. The mountains are mainly composed of trachytic porphyry; with slate, limestone, etc., appearing on the sides of the chains, and sometimes rising up with the porphyry. Granite is also met with, but is not frequent; and in the north Tertiary fossiliferous rocks are found. Its volcanoes are all quiescent, unless we except Ararat, of which an eruption took place in 1840, accompanied by a disastrous earthquake. A few mountains, as Ararat, Alaghez, and Bangöldagh, rise above the line of perpetual snow, but this is not generally the case; and there are no passes but such as can be crossed in a single day. Silver, lead, iron, and copper are found in the mountains; and the last two have to some extent been wrought in modern times. Rock salt is plentiful, and is exported in considerable quantities to Persia and elsewhere. Mineral waters abound, but little or nothing is known of their qualities. Several important rivers take their rise in Armenia, namely the Kur or Cyrus, and its tributary the Aras or Araxes, flowing east to the Caspian Sea; the Akampsis or Tchorak, and the Halys or Kizil-Irmak, flowing north to the Black Sea; and the Tigris and Euphrates, which flow into the Persian Gulf. There are also several minor tributary streams. The only considerable lakes are those of Van, 70 miles in length and about 28 in breadth; Goukcha, Sevanga or Sevan northeast of Erivan, about 40 miles long by 15 broad; and Urumiyah.

The climate of Armenia is very severe, presenting a marked contrast to that of the warm regions of the Lower Euphrates, and to the mildness prevalent on the shores of the Black Sea. Winter in Armenia continues from October to May, spring and harvest a month each, and the change to the summer is very rapid. The heat, especially in the valleys, during summer, is great, and rain seldom falls. In Erivan, which is a degree of latitude south from Trebizond, the thermometer in winter falls 36° F. lower than it does in the latter; and in summer it rises 24° F. higher. On the plateaux of Erzeroom, Gumri, etc., the difference is still greater; indeed, in the town of Erzeroom the snow lies in the streets for eight months of the year. East and southeast winds in summer, west winds in spring and northeast storm winds in winter, are most prevalent. The soil of Armenia is reckoned on the whole productive, though in many places it would be quite barren were it not for the great care taken to irrigate it. Wheat, barley, tobacco, hemp, grapes, and cotton are raised; and in some of the valleys apricots, peaches, mulberries, and walnuts are grown. From the nature of the country the rearing of stock is carried on to a greater extent than agriculture. The horses are spirited, fleet, and fiery. Pines, birches, poplars, and beeches flourish, but there are no thick forests, except in the northern parts of the country. The flora is not so varied as might be expected in such an Alpine country; in several respects it resembles the vegetation of the Alps of Tyrol and Switzerland.

The inhabitants are chiefly of the genuine Armenian stock; but besides them, in consequence of the repeated subjugation of the country, various other races have obtained a footing. Of these the principal are the Turcomans, who still maintain their nomadic habits, and from whom the country has received the name of Turcomania. In the southern portion are the predatory Kurds and the Turks; on the Tchorak, Georgians; and throughout the whole country, Greeks, Jews, and Gypsies. The total

number of Armenians has been estimated at 2,000,000, of whom probably one half are in Armenia. The remainder, like the Jews, are scattered over various countries, and being strongly addicted to commerce, play an important part as merchants. They are found over all western Asia; about 200,000 are in Constantinople and its vicinity; numbers are in Russia, Hungary, and Italy; some in Africa and America; and a large number in India, chiefly in the great marts, Bombay, Madras, and Calcutta. Everywhere they are engaged in banking and trading. Their eyes and hair are black, their look lively, noses aquiline, and their complexion somewhat swarthy. The women are remarkable for the delicacy and regularity of their features. Like the Jews, whom in many respects they resemble, their ruling passion appears to be an inordinate love of gain, but they are generally esteemed honest. Their mental capacity is good, and those who are educated are distinguished by superior cultivation and refined manners; but the mass of the people inhabiting their native country, in consequence of centuries of neglect, are grossly ignorant and superstitious.

History.— The legendary history of Armenia begins with Haïk, son of Togarmah, the great-grandson of Noah, mentioned in Gen. x. 3. He is said to have taken refuge in Armenia from the tyranny of Belus, king of Babylon, who was slain in pursuit of him. The seventh king in descent from Haïk was killed in battle with Semiramis, and the country became tributary to Assyria. From Haïk the country derived the name Haikistan, and from Aram, his sixth successor, that of Armenia. Armenia continued subject to Assyria under its own princes till the revolt of the Medes and Babylonians against Sardanapalus, when Barbak, the king of Armenia, joined these powers and recovered his independence. Tigranes I. is said to have been the ally of Cyrus against Astyages, and to have built the city of Tigranocerta. His successor, Vhakin, the legendary hero of Armenia, was deified after his death. Vahi, the last of the dynasty of Haïk, was killed in fighting against Alexander as the ally or vassal of Darius. The duration of the dynasty was about 1,800 years. Armenia was now incorporated with the kingdom of Syria. It recovered its independence under Ardvates, 317 B.C., during the dissension among the successors of Alexander, but on his death submitted to the Seleucidæ. About 190 B.C. Artaxias and Zariadres, two Armenian nobles, freed themselves from the dominion of Antiochus the Great and established the kingdoms of Armenia Major and Armenia Minor. Armena Major was re-conquered from Artaxias II. by Antiochus Epiphanes. About 149 B.C. Mithridates, or Arsaces VI., king of Parthia, whose dominion extended over Media, Persia, and Babylonia, placed his brother Waghershag or Valarsaces on the throne of Armenia, and introduced the dynasty of the Arsacidæ into the country. He built cities and organized the defenses of the country. His great-grandson, Tigranes II., whose long reign appears to have begun about 96 B.C., conquered Artenes, king of Sophene or Armenia Minor, and united all Armenia under his sway. He was successful in war against the Parthians, and made himself master of the whole Syrian monarchy. He is also said to have founded or built Tigranocerta, the origin of which is likewise attributed to his probably mythical predecessor. Being the son-in-law of Mithridates, king of Pontus, while Mithridates was preparing to renew his war with the Romans after the death of Sulla he invaded Cappadocia at his instigation and carried away much spoil and many prisoners. Mithridates, after his defeat, took refuge with Tigranes, who does not seem to have been disposed to render him active assistance; but Lucullus made a peremptory demand through Appius Clodius for his surrender, which left Tigranes no alternative but a declaration of war, 69 B.C. Disregarding an invasion of Cilicia, Lucullus at once carried the war into Armenia, defeated the numerous forces of Tigranes, and captured Tigranocerta. Antiochus Eusebes was reinstated on the throne of Syria, and other dependents of Tigranes revolted. Tigranes in the meantime, with the assistance of Mithridates, collected another army which was again defeated by Lucullus. Favored by disaffection among the Roman troops, however, Tigranes recovered the greater part of Armenia, and defeated Fannius, the lieutenant of Lucullus. Pompey, who arrived in 66 B.C., after overthrowing Mithridates, who had also recovered his dominions, advanced to Armenia, which was at the same time invaded by the Parthians, instigated by the revolted son of Tigranes. The Parthians speedily withdrew, and young Tigranes fled to Pompey. At this critical juncture the elder Tigranes hastened to make his submission to the Roman general, who left him in possession of his kingdom, but deprived him of the provinces of Sophene and Gordyene, which he erected into a kingdom for the younger Tigranes. The elder Tigranes continued faithful to the Roman alliance, and Gordyene, which had been seized by the Parthians, was soon after restored to him. Tigranes died about 55 B.C. His son Artavasdes was made prisoner by Antony and carried to Egypt, where he was put to death by Cleopatra in 30 B.C. Armenia continued subject to the Romans, who appointed its princes from the family of the Arsacidæ till the time of Trajan, who made it a province. It was given up by Hadrian and again ruled by the Arsacidæ. Chosroes defended it during a long reign against the power of Persia, which had recently re-established its monarchy on the ruins of the Parthian empire; but about 258–259 A.D. Sapor, king of Persia, unable to subdue Chosroes by force of arms, caused him to be assassinated, and his son Tigranes being an infant, took possession of the country. Tigranes was restored by the Romans in 286, the third year of Diocletian. At the beginning of his reign he persecuted the Christians, who were numerous in Armenia, but was himself converted to Christianity, it is said, by Gregory the Illuminator. Armenia was thus the first country which officially embraced Christianity. On the defeat of Galerius by the Persians in 296 Tiridates, who fought valiantly as the ally of the Romans, was compelled to follow the retreat of his protectors; but the succeeding campaign restored him, and his dominions were extended in the peace with Persia which followed. By the treaty into which Jovian, the successor of Julius, entered with Sapor II. 363 A.D., the Romans were compelled to abandon the protection of Armenia. It was speedily reduced to a

Persian province, but after the death of Sapor its independence was restored in a new treaty of peace made with Theodosius in 384. The country, long oppressed by the contentions between the Romans and Persians, soon fell into division through the attraction of these rival powers. A Persian king or governor, Chosroes, was set up over the eastern, and a Roman, Arsaces, over the western portion of the country, both being of the royal house of Armenia. On the death of Arsaces the Romans suppressed the form of royalty, and annexed their portion of the country to the empire under the military command of a count of the Armenian frontier. This occurred in the reign of Theodosius II. On the death of Artasires or Ardashir, the successor of Chosroes, Bahram V. of Persia (about 431) annexed the Persian portion under the name of Persarmenia. The Persians exerted themselves to extirpate Christianity, but failed to do so; and on the fall of the Sassanidæ (632) the country was united again under the Greek empire. It now became the scene of incessant struggles between the declining empire and the rising Mohammedan power, and as it was persecuted by the emperors for its adoption of the Monophysite heresy its sympathies were not always with the former. The dynasty of the Pagratids or Bagratidæ was established by the arms and influence of the caliphs. It was a family of Jewish origin and appears to have risen gradually to influence in the country. The date of its elevation to royalty is usually given as 885, but a much earlier date is sometimes assigned. It lasted till 1079, when the country again became dependent on the Greek empire. During this period several other dynasties which it is not necessary specifically to notice reigned simultaneously in different parts of the country. On the fall of the Pagratidæ a relative of the last king founded a small kingdom in the north of Cilicia, which gradually extended to the Mediterranean, and was known as Lesser Armenia. It was overthrown by the Mamelukes in 1375. Armenia formed part of the empires of Genghis Khan and Tamerlane, and a great part of it was conquered by Selim II. in 1522. Henceforth it was shared between the Turks and Persians, the former having the greater part of it. In 1828 Russia obtained a considerable portion of it, and this was greatly augmented by the treaty of Berlin (1878). Russian Armenia includes the governments of Erivan and Elizabethpol, the territory of Kars, etc., with the important towns of Tiflis, Kars, and Erivan. At the time of the Berlin treaty Turkey made promises of better treatment for her Armenian subjects, but these have been disregarded and in 1895–6 many thousands of the Armenians in different localities were massacred and atrocious cruelties perpetrated upon them by the Turks, with full approval, it would seem, of the Sultan and his advisers.

Art.— The only important ruins of the Roman period are at Karni. After the country had become Christian many churches were built, possessing much architectural character. The most interesting of these is the cathedral at Ani, built about 1010, while of nearly equal importance is the cathedral of Kiutas, on the basilican plan. A church with a striking dome and five naves is found at Mowki, and there are many others remarkable for the delicacy of decorative details. The most richly ornamented of these is that at Mtzkhet in Georgia. The Armenian architects and artists were much given to the employment of decorative inscriptions, as were their Mohammedan neighbors. Carving in wood and ivory were much practised, but the Armenians especially excelled in the production of cloisonné enamel and in the employment of geometric ornament applied to buildings as well as to small objects, such as the sacred vessels of the church and toilet articles. Wall painting was also an Armenian accomplishment and one in which not a little independence of Byzantine influence was exhibited.

Armenian Church.— The Armenians received Christianity as early as the 3d century. During the Monophysitic disputes, being dissatisfied with the decisions of the Council of Chalcedon (451), they separated from the Greek Church in the year 536. The Popes have at different times attempted to gain them over to the Roman Catholic faith, but have not been able to unite them permanently and generally with the Roman Church. There are, however, at present, about 100,000 United Armenians who acknowledge the spiritual supremacy of the Pope; they agree in their doctrines with the Catholics, but retain their peculiar ceremonies and discipline. At different times force has been used to make them conform to the religion of Mohammed; but the far greater part are yet Monophysites, and have remained faithful to their old religion and worship. Their doctrine differs from the orthodox chiefly in their admitting only one nature in Christ, and believing the Holy Spirit to issue from the Father alone. In their seven sacraments, which they call mysteries, there are these peculiarities, that in baptism they sprinkle thrice and dip thrice, and this is immediately followed by confirmation; that in the Lord's Supper they mix no water with the wine, and use leavened bread, which they distribute dipped in wine; and that they allow extreme unction only to divines immediately after their death. They adore saints and their images, but do not believe in purgatory. In fasting they surpass the Greeks. Their feasts are fewer than those of the Greeks, but they celebrate them more devoutly. They worship, in Turkey, mostly in the night time; the mass is said in the ancient Armenian, the sermon is preached in the modern. Their hierarchy differs little from that of the Greeks. The *catholicus* or head of the Church has his seat at Etchmiadzin, a monastery near Erivan, the capital of the Russian Armenia, on Mount Ararat. The holy oil, which he prepares and sells to the clergy, and the frequent pilgrimages of the Armenians to Etchmiadzin, supply him with means for the support of a magnificent style of worship and of establishments for education. He maintains in his residence a seminary for the education of divines. There is here also a printing press. The patriarchs, bishops, and archbishops of the Armenians are invested by him, and every three years confirmed in their offices or recalled. The remainder of the clergy resemble the priests of the orthodox church in rank and duties. The monks follow the rule of St. Basil. The *vartabets,* who live like monks, cultivate the sciences, take degrees, which may be compared with the usual academical honors, and are the vicars of the bishops, form a class of divines peculiar to

the Armenian Church. The secular priests must be married once, but are not allowed to take a second wife. Both monks and clergy in general are ignorant and superstitious. Armenian churches have been established in the United States wherever a considerable body of Armenian refugees have settled.

Language and Literature.— The Armenian language belongs to the great Indo-European family of languages, and is most closely connected with the Iranic group. The Old Armenian or Haikan language, which is still the literary and ecclesiastical language, is distinguished from the New Armenian, the ordinary spoken language, which contains a large intermixture of Persian and Turkish elements. The most learned Armenian antiquaries do not pretend to trace their literature further back than about 150 years before the Christian era, when Marabas Catina wrote a history of Armenia, and earned for himself the title of the Armenian Herodotus. He was followed by some half dozen historians and mythologists, but all these early productions are lost, though they have not been quite valueless, inasmuch as they were the sources whence later Armenian writers compiled works still extant. The authors who lived in the 4th century of the Christian era are the first whose writings have been preserved. Christianity then prevailed in Armenia, and her authors were princes and prelates. The 5th century was the golden age of Haikan literature. This century was fruitful in authors, and was further distinguished by two events important to the progress of learning. The Armenians till then had had no alphabet of their own, indifferently using Greek, Syriac, and Persian characters. Early in the 5th century Mesrop Masdoty invented a Haikan alphabet of 38 letters, still called, in honor of the inventor, Mesropian, and now employed as capitals, since others of more convenient form have supplanted them in common use. About the same time schools were instituted throughout Armenia, and the scholars there trained exerted themselves in producing Haiken versions of the Bible, and of the masterpieces of Greece and Rome. One of the most distinguished authors who now appeared was Archbishop Moses Chorenensis or Chorenabyi. Besides innumerable translations, he wrote a history of Armenia, a treatise on rhetoric, and a treatise on geography — all of which, together with some homilies, have been preserved, as well as some hymns still habitually sung in the Armenian Church service. His 'History of Armenia' was published in 1736, with a Latin translation, by the celebrated W. Whiston and his son George. In the 6th century Haikan literature first remained stationary, and then began to decline. This decline continued down to the 16th century. During this period authors abounded, but in a literary sense their productions were worthless. A few histories, however, national, Tartar, Arab, etc., some of them in verse, deserve esteem for the information they contain. In the 17th century Armenian schools and colleges arose in the East and in the West, Armenian printing presses were set up in various towns, and Armenian literature began to revive. In the 18th century the revival was complete, very much owing to the zealous and judicious exertions of Petro Mechitar, a Catholic Armenian, who in 1701 founded a religious society at Constantinople for the purpose of elevating the Armenians by diffusing among them a knowledge of their ancient literature and language. Being persecuted by the opposite sect he fled with his adherents to the Morea, then under the Venetians, and established a monastery and academy at Modon. The Morea reverting to the Ottoman sceptre, Mechitar transferred his institution to the small island of San Lazaro at Venice, where it has ever since remained and prospered. Abbot Mechitar, during the remainder of his life (he died in 1749) successfully exerted himself to render his monastic college the chief seat of Armenian erudition and education. The best Armenian press extant is the Mechitarist, from which issues a newspaper that circulates widely in the Levant. Here many of the classical works of England, France, Italy, and Germany have been translated into Armenian. There is also a Mechitarist college in Vienna, and a branch in Munich. Wherever any extensive community of Armenians have settled they have set up a printing press, as in Amsterdam, Leghorn, Moscow, Venice, Astrakhan, Constantinople, Smyrna, Tiflis, St. Petersburg, Madras, Calcutta, etc., and at several of these places periodicals are published. The best Armenian dictionaries for foreigners are the Armenian-French one published at Venice in 1812; the Armenian-Italian of Emmanuel Tchaktchak (Venice 1837); the Armenian-English of Aucher as improved by Bedrossian (Venice 1868–79); both Armenian-English and English-Armenian); and the French-Armenian of Norayr (Constantinople 1884).

Bibliography.— Creagh, 'Armenians, Koords and Turks'; Gladstone, 'The Armenian Question'; Greene, 'The Armenian Crisis and the Rule of the Turk'; Gregor, 'History of Armenia'; Norman, 'Armenia'; Lynch, 'Armenia'; Nazarbek, 'Armenian Revolutionists upon Armenian Problems'; Vartooguian, 'Armenia's Ordeal'; Hanrachod, 'Chronological Succession of the Armenian Patriarchs'; 'Life and Times of St. Gregory, the Illuminator'; Bedrossian, 'New Armenian Dictionary'; Msériantz, 'Studies on Armenian Dialectology.'

Arme'nian Art. See Armenia.

Arme'nian Church. See Armenia.

Arme'nian Language and Literature. See Armenia.

Armentieres, är'mäṅ'tyâr' (Latin, *Armentaria*), a town in France, on the Belgian frontier, 10 miles west-northwest of Lille, on the Lys. The town has a communal college and factories for spinning flax, hemp, and cotton yarn. There are also manufactories of woolen cloth, table linen, calicoes, lace, thread, beetroot sugar, and tobacco; bleachfields, distilleries, soap-works, tanneries, and salt-refineries, with a considerable trade in grain, brandy, iron, tobacco, soap, etc. Bricks are made in the neighborhood in large quantities. Pop. (1901) 29,401.

Arm'felt, Gustav Moritz, Count of, a Swedish soldier: b. 1757; d. 1814. Though he had been highly favored by Gustavus III., he incurred the enmity of the Duke of Sudermania, guardian to the young king, Gustavus IV., and was deprived of all his titles and possessions. He was restored to his fortune and honors in 1799, when Gustavus IV. attained his majority,

and held several high military posts. Subsequently entering the Russian service, he was made count, chancellor of the University of Åbo, president of the department for the affairs of Finland, member of the Russian Senate, and served in the campaign against Napoleon in 1812.

Armida, är-mē'dȧ, the beautiful enchantress in Tasso's 'Jerusalem Delivered.' She succeeds in bringing the hero Rinaldo to her enchanted gardens, where he forgets his vows for a time. Messengers from the Christian host having arrived, Rinaldo escapes with them by means of a powerful talisman. In the sequel Armida becomes a Christian.

Armies. See ARMY.

Ar'millary Sphere (L. *armilla*, a hoop), an astronomical instrument composed of a series of rings, all circles of one sphere, intended to represent the principal circles of the celestial globe, the rings standing for the meridian of the station, the ecliptic, the tropics, the Arctic and Antarctic Circles, etc., in their relative positions. Its purpose is to represent the apparent motions of the solar system.

Arminianism, a term applied to a certain phase of Protestant theology. In the Netherlands early in the 17th century there was a revolt against the doctrine of unconditional election as taught by the rigid Calvinists. The most important person, though not the first one, in this revolt was James Arminius (q.v.). A controversy was carried on between him and Gomarus over the question of predestination, and, after the death of Arminius, with increased vigor by their followers. In 1610 the Arminians set forth their views in a 'Remonstrance' covering the points in controversy which in substance was as follows:

(1) God decreed to save through Christ those who believe in his Son and who persevere in faith and obedience through life, but he leaves in sin those who are not believers. (2) Christ died for all, but no one except the believer has remission of sins. (3) Man can neither do nor think anything truly good until he is born again through the Holy Spirit. (4) All good in the regenerate man is brought about by the grace of God, but this grace is not irresistible. (5) Those who are truly converted have power given them through the Holy Spirit and the help of Christ, so that if they desire his aid and are not inactive, no power can take them away from Christ.

In 1618 the Synod of Dort met and condemned the five articles, and many of the remonstrant ministers were deposed, but in 1630 they were granted religious liberty. They have continued to the present as one of the smaller religious sects of Holland with a presbyterial organization and a theological seminary at Amsterdam. The present importance of Arminianism is due to the fact that the founders of Methodism (q.v.) incorporated into their system the teachings of Arminius and his immediate followers. This is the belief of the Methodist Church to-day, as well as that of many individuals belonging to churches nominally Calvinistic.

Armin'ius, a German chief celebrated by his fellow-countrymen as their deliverer from the Roman yoke: b. about 18 B.C.; assassinated A.D. 19. Sent as a hostage to Rome he served in the Roman army, and was raised to the rank of *eques*. Finding on his return to Germany that the Roman governor, Quintilius Varus, was making efforts to Romanize the German tribes near the Rhine, he placed himself at the head of the discontented tribes and completely annihilated the army of Varus, consisting of three legions, in a three days' battle fought in the Teutoberg forest. After many years' resistance to Rome he drew upon himself the hatred of his countrymen by aiming at the regal authority, and was assassinated. A national monument to his memory was erected on the Grotenburg, near Detmold, in 1875.

Armin'ius, Jacobus, the founder of Arminianism (q.v.): b. Oudewater, Holland, in 1560; d. in 1609. He early showed marked promise as a scholar, and entered the University of Leyden at the age of 15. His ability was so apparent that certain officials of Amsterdam undertook the expense of his education for the service of the Church. This enabled him to study at Geneva, where Beza was at the height of his influence and by whom Arminius was greatly influenced. He also studied at Basel and Padua and visited Rome. Returning to Holland he was ordained in 1588 and became pastor of the Reformed Church at Amsterdam. At that time he was a rigid Calvinist, but milder views of predestination than those which he had learned from Beza having made their way into Holland, Arminius was called upon for a defense of Calvinism. He made a more careful examination of the disputed points and as a result modified his own views, though still holding to predestination. In spite of the opposition which arose because of his changed opinions he was offered and accepted a professorship in the University of Leyden in 1603. A controversy soon broke out between him and his colleague, Gomarus, a zealous and extreme Calvinist. Two parties were formed in and beyond the university, and the controversy was kept up till his death in 1609. See ARMINIANISM.

Ar'mistead, George, an American soldier: b. in New Market, Va., about 1780; d. in 1818. He entered the United States army in 1799, became a major in 1813, and distinguished himself for bravery at the capture of Fort George in Canada in 1813 and the defense of Fort McHenry near Baltimore the next year.

Ar'mistice, a suspension of hostilities between two belligerent powers or two armies by mutual agreement. It may either be for a definite period or until its termination is proclaimed. An armistice throughout the whole theatre of war can be concluded only by the belligerent governments, and does not take full effect until it has been ratified. A partial armistice may, however, be concluded by the commanders of individual armies or army corps, and such an armistice requires no ratification, although it may be disapproved and abolished by the government. An armistice is often concluded for only a few hours to bury the slain, remove the wounded, and exchange prisoners, as also sometimes to allow of a parley between the opposing generals. A breach of an armistice is regarded as a violation of the law of nations. Sometimes a regular armistice is pre-

ceded by an actual suspension of hostilities. If the conditions on which an armistice was agreed upon, as that while it lasted all preparations for attack or defense should cease, are violated by either side, the enemy is entitled to resume hostilities at once. A general armistice is usually the preliminary of a peace, and can only be proclaimed by the commanders-in-chief or their home governments.

Ar'mitage, Edward, an English historical and mural painter: b. London, 20 May 1817; d. in 1896. He studied in Paris, where, in 1842, he exhibited his first independent work. In the following year his 'Landing of Cæsar' gained a prize of $1,500 in London; and in 1845 and 1847 he carried off prizes of $1,000 and $2,500. He was made a fellow of the Royal Academy in 1872, and in 1875 was appointed lecturer on painting there. His mural paintings include a series of noble figures of Christ and the 12 apostles, executed for Saint John's Roman Catholic Church in London.

Ar'mitage, Thomas, an American clergyman: b. Pontefract, England, 2 Aug. 1819; d. Yonkers, N. Y., 20 Jan. 1896. He prepared himself for the ministry and preached his first sermon when 16 years old. Coming to New York city in 1838, he was actively engaged in the ministry of the Methodist Church until 1848, when he became a Baptist, and was pastor of the Norfolk Street Church (later the Fifth Avenue Baptist Church). In 1890 he was made pastor emeritus, given a residence in Yonkers. He was one of the founders of the American Bible Union. He published 'Jesus: His Self-Introspection' (1878); 'Lectures on Preaching' (1880); 'History of the Baptists' (1886).

Ar'mor. See ARMS AND ARMOR.

Armorclads. See WARSHIPS.

Ar'mor-plate, in modern usage, a metallic covering for ships or fortifications, intended to furnish protection against gun-fire. John Stevens of Hoboken, N. J., is universally credited with having originated the idea of applying armor to the sides of ships, he having designed a vessel with battery protected by inclined armor and submitted her plans to the United States government during the War of 1812; but it was the development of the naval shell gun which led to the actual use of armor. The annihilation of the Turkish fleet at Linope in 1853 first drew general attention to the necessity of providing some protection against explosive shell, and the incident was soon followed by the construction of armored ships in the United States, France, and England. The "Stevens Battery," a steam, armored war vessel, was begun in the United States in 1854, a few months earlier than the first ironclad was laid down in Europe, but the French were the first to complete their vessels, and on 17 Oct. 1855, the Devastation, Love, and Tounante, the first ironclad squadron ever seen, after a close engagement of four hours, silenced the Russian forts at Kinburn, which had previously held the combined fleets of France and England at bay. No sooner, however, had the first thin iron plates proved themselves an effective shield against gun-fire, than the introduction of new and more powerful guns forced a corresponding development in the thickness and quality of armor. The progress of the contest is shown by the facts that, while in 1863 4½-inch iron plating made a ship invulnerable, in 1868 9-inch plating was required to the same end, and in 1872 a 12-inch plate was pierced on the firing ground. With the production of 12-inch plates the limit of regularity in manufacture with wrought iron seemed to be reached, and the cost of the plate upon plate system, owing to the difficulty of making the plates fit each other, led to the use of the sandwich system, in which layers of wood separated layers of iron plating. The advent of the Krupp 14½-inch rifle and of the Woolwich 81-ton gun marked the final supremacy of the gun. Wrought iron armor had then reached its highest development on the British ship Inflexible, which was protected by two layers of 12-inch plates with 11 inches of teak between them and backed by 6 inches of teak and two 1-inch skin plates. Compound armor, composed of a hard steel face welded upon a wrought iron back, next came into general use, but homogeneous steel, first made in the form of heavy plating by Schneider & Co. of France, disputed with it for the palm and finally proved its superiority. In 1890 nickel steel had its first public trial, on the United States naval proving ground at Annapolis, Md., in competition with compound armor and with homogeneous steel; and in the same year a steel plate hardened on one face was also tried at Annapolis and showed phenomenal resistance to perforation. Further tests demonstrated the decisive superiority of the surface-hardened steel plates, called Harveyized from the inventor of the process, and in a very short time they were universally adopted for armoring ships. The following briefly describes the method of manufacturing this armor. The ingot, of approximately rectangular cross section and about twice the weight of the finished plate, is made of open-hearth steel, sufficient nickel being added to the furnace charge to give about 3¼ per cent in the casting. After cooling, the ingot is stripped, reheated, and forged to nearly the required thickness, being handled by a porter bar forged from the upper end, and the entire forging operation usually requiring several heats. In the early days of steel armor manufacture immense steam hammers were used for forging, but now hydraulic presses are preferred. After forging, the upper end of the plate is cut off under the hammer or press, and the remainder, after cooling, placed in the Harveyizing furnace with its back and sides well protected by refractory materials and its face covered with a carbonizing mixture, where it is raised to a high temperature and left to soak for several days. When the carbon has penetrated sufficiently into its face, the plate is removed from the furnace and given a secondary forging which reduces it to the required thickness, after which it is trimmed to size in a planer and its face is cleaned. The next operation consists of heating the plate and chilling its surface with a spray of cold water, which hardens the highly carbonized face but leaves the body of the plate still soft. If the plate is to be bent or curved this operation is performed under a press after the carbonizing but before the final heating for hardening the face. The final operation is boring and tapping the bolt holes in the back of the plate. If holes are required for structural purposes in the hard

face of a plate, it is softened at the proper places by means of an electric current, since otherwise it will resist any tool. Within the last few years improvements upon the Harvey process have been developed by Krupp at Essen, and the Krupp process is now widely used. The details are kept secret, but it is probable that the essential feature is the use of chrome as well as nickel in the steel, this alloy permitting the chill to be carried deeper into the plate than when steel containing nickel only is used. The supercarbonization, though brought about by the use of a hydrocarbon gas, is the equivalent of ordinary cementation, and the usual cold spray is used to chill the surface. Kruppized plates offer some 20 per cent more resistance to ordinary armor-piercing projectiles than Harveyized plates, but when attacked by the capped projectiles now coming into general use the gain in resistance is much less. Their freedom from cracking is a further point of superiority. The armor applied to the protection of ships is also used on coast and frontier defenses, but another armor, ill adapted to naval use on account of its weight, has also been developed. Chilled cast iron was first tested as armor in Prussia in 1868, and then and in many subsequent trials showed remarkable resistance to gun-fire. The Grason system, in which ellipsoidal-shaped turrets are built up of very heavy iron castings, chilled on the outer surface, and fitted together without bolts, has been largely used for land fortifications in Europe.

Backing and Fastenings.— Armor was first applied to wooden ships, and when iron and steel ships succeeded these it was found necessary to interpose wood between the skin-plating of the ship and the armor to provide a surface which could be trimmed to fit the latter, and to decrease the injury caused to the ship's side by the impact of shot. East India teak is used for armor backing, but the modern tendency is to reduce its thickness as far as is practicable, and even to dispense with it entirely in above-water structures. Through bolts were first used for fastening armor to ships, but they caused leaks, besides weakening the armor, and the bolts now used only screw a short distance into the backs of the plates, being set up with nuts on their inner ends. They are made of forged steel; have shanks of reduced diameter to prevent breaking at the threads; have packing to prevent leakage around them; and usually have rubber washers under their nut heads. One bolt is used to about every 4½ square feet of plating, and their diameters are from 1½ to 3½ inches according to the thickness of the armor.

Disposition and Uses.— When sea-going armored ships first began to be built it was possible to completely cover them with armor then impenetrable, but the increasing power of guns soon made it necessary to restrict the defended area if it was to be given complete protection. In the hopeless attempt to secure invulnerability armor was gradually stripped from other portions and concentrated over parts considered vital. The restriction of batteries to a few heavy guns, mounted in turrets or a central citadel, allowed the thickness of armor protecting men and guns to be greatly increased, with a corresponding reduction in its extent, and at the same time water-line armor was made thicker and thicker and of less and less area. Of late years, however, there has been a growing tendency to return to the early practice of expanding armor over a large area. Great as are the displacements of modern battleships it is not deemed wise to attempt to secure complete protection for any one portion of them; it is recognized that armor can only be expected to furnish a reasonable amount of security to what it covers; to keep out all small projectiles; and above all to keep out explosive shell with large bursting charges, compelling resort to armor-piercing shell. Modern battleships often carry as much as 4,000 tons weight of armor. The principle of inclining armor so as to cause it to deflect projectiles is largely used in protective decks covering the propelling machinery, and also to some extent in shields for the defense of guns' crews. Hard-faced armor plates of as great weight as 50 tons and of as great thickness as 18 inches have been applied to ships, but in the best present practice a thickness of 12 inches is seldom exceeded. A width of about 9 feet and a length of about 18 feet are the limiting sizes of armor plates now made. Modern naval guns, firing capped projectiles, will more than overmatch the best armor plate, of thicknesses equal to their respective calibres, up to 3,000 yards' distance, provided the impact be normal to the plate's surface, but the fact that in actual battle most impacts will be at some inclination to the surface struck adds greatly to the real value of armor. There are two great plants in the United States for the manufacture of armor — the Bethlehem Steel Co. at Bethlehem, Pa., and the Carnegie Steel Co. at Pittsburg. The greatest foreign plants are at Sheffield, England, at the Creusot and the St. Chamoud works in France, and at Krupp's works in Germany.

PHILIP R. ALGER,
U. S. Naval Academy, Annapolis.

Ar'mored Train, a modern instrument of war severely tested in the American operations against Filipino insurgents in 1898–99, and in those of the British against the Boers in 1899–1900. Credit has been given to Admiral Fisher of the British navy for the first use of the armored train in war, when, in 1882, he covered a locomotive with boiler plate and equipped cars, similarly protected, with field guns and put them to effective practical use. But the germ of the idea was of earlier date. When the Germans invested Paris, the French made frequent sorties from the city, and in many of these attacks were assisted by field guns mounted on wagons and carriages. Later they were mounted on railroad cars, which were protected in their vital points against the enemy's guns. Since 1882 most of the military powers of Europe have been experimenting in this direction and Great Britain has now probably the most complete and efficient armored trains in the world. The best that the British army possesses is the engine and train of the First Sussex Artillery Volunteers. The model design was made from special designs for war purposes. The protected engine carries a Maxim gun, and the protected cars have heavy field guns, operated by machinery, so that any part of the surrounding country can quickly be covered. Arrangements are made to compensate for the recoil, and also to give steadiness and stability to the cars. This latter is accomplished by an arrangement

for clamping the truck to the rails by strong screw clips whenever the gun is fired. There are also several steel-plated vans accompanying the train, in which horses and soldiers can be safely conveyed. This type of movable fortress performed notable achievements in South Africa, and in the sorties from Ladysmith and Kimberley was the chief implement that forced the Boers back. With machine guns and field pieces the moving train becomes a valuable offensive apparatus, being able to move up close to the enemy's lines or retreat to a point beyond the range of small arms. The rapidity with which the train can change its base of action renders it a difficult object for the batteries of an enemy to hit, and almost the only way to defeat its operations is to wreck or derail it; it then becomes a helpless target for long-range guns. Probably the first attempt in the United States to provide an armored car was that made by the Michigan Central Railroad Company, on the order of the American Express Company, for the purpose of protecting the valuable articles carried on its special express trains. These armored or «arsenal cars» were so constructed as to make the centre of them with its steel plating a thoroughly bullet-proof room, with apertures so disposed as to enable the guards within to resist an attack by thieves from any quarter. During the remarkable dash of the American troops in the Philippines into the northern part of the island of Luzon, in search of the fugitive insurgent leader Aguinaldo, in 1899, much effective work was accomplished by an improvised armored train.

Ar'morer, a term formerly applied to a maker of arms and armor, a very important handicraftsman in the Middle Ages and down to the end of the 16th century and even later. (See ARMS AND ARMOR.) At the present day the term denotes persons employed to keep the arms of the soldiers in repair, or the custodian of an armory. On board a man-of-war the armorer is a petty officer appointed to keep the small arms in complete condition for service.

Armor'ica, the country of the Armorici. The name was formed from two Celtic words signifying «upon the sea,» and was apparently applied in ancient times to the whole northern and western coast of Gaul. It was afterward confined to the province of Brittany.

Ar'mory, a building, or military station appropriated to the storage of arms, or the use of troops. In the United States the term is generally applied to the headquarters of the local militia, and signifies almost the equivalent of a club house, to which is added a drill shed, for military manœuvres.

Ar'mour, Herman Ossian, an American merchant: b. Stockbridge, N. Y., in 1837. After several years spent in the grain commission business in Chicago he became in 1865 the New York representative of the Milwaukee packing firm of Armour, Plankinton & Co., which retained the firm name of H. O. Armour & Co. until 1870. The name was then altered to Armour & Co., which is now the most important provision firm in the world.

Ar'mour, Philip Danforth, an American philanthropist: b. Stockbridge, N. Y., 16 May 1832; d. 6 Jan. 1901. He was a miner in California in 1852–56, but engaged in the commission business in Milwaukee in 1856–63; and later became the head of the pork packing firm of Armour, Plankinton & Co., Chicago. He founded the Armour Mission and the Armour Institute of Technology (q.v.), both in Chicago; the former at a cost of about $250,000, and the latter with an endowment of $1,500,000, subsequently increased.

Ar'mour Institute of Technology, an American co-educational institution, founded in Chicago, Ill., by Philip D. Armour, in 1893. Its scheme includes (1) The Technical College; (2) The Department of Commercial Tests; (3) The Armour Scientific Academy. The institution had 666 students in 1901 and 38 professors in its faculty. Its property was valued at $4,560,000.

Arms and Armor. The earliest arms were everywhere made of stone. Stone was succeeded by bronze in the manufacture of weapons of war. The commonest warlike relics of the bronze age that have come down to us are daggers and spear-heads. From the descriptions of Homer we know that almost all the Grecian armor, defensive and offensive, in his time was of bronze, although it is evident that iron was sometimes used in the time of Homer for making weapons, from the fact that he occasionally uses the Greek word for iron (*sidēros*) for a sword. Not the sword, however, but the lance, spear, and javelin, were the principal weapons of this age among the Greeks. The bow is not often mentioned, although a bow belonging to Pandarus is described in the Iliad, and in the Odyssey Ulysses is represented as very expert in the use of this weapon. Among the most ancient nations the Egyptians seem to have been most accustomed to the use of the bow, which was the principal weapon of the Egyptian infantry. The Egyptian bow was somewhat shorter than the height of a man; the arrow was usually made of reed, the head of bronze, but sometimes of flint. Peculiar to the Egyptians was a defensive weapon the object of which was to catch and break the sword of the enemy. With the Assyrians also the bow was a favorite weapon; but with them lances, spears, and javelins were in more common use than with the Egyptians. Most of the large engines of war, chariots with scythes projecting at each side from the axle, catapults, and ballistæ, seem to have been of Assyrian origin. All of those mentioned can at any rate be traced back to the Assyrians, to whom the invention of the catapult and the ballista was attributed by classical writers. During the historical age of Greece the characteristic weapon was a heavy spear from 21 to 24 feet in length. The sword used by the Greeks was short, and was worn on the right side. The Roman sword was of Spanish origin, from 22 to 24 inches in length, straight, two-edged, and obtusely pointed, and as by the Greeks was worn on the right side. It was used principally as a stabbing weapon. On the Trajan column, belonging to 114 A.D., the sword appears considerably longer than that used at an earlier period. The Roman sword was originally of bronze, but like all other offensive weapons among the Romans was always of iron in the time of Polybius (2d century B.C.), when bronze continued in use only for defensive armor. The characteristic weapon of the Roman soldier was the pilum, a kind of

pike or javelin, about 5 or 6 feet in length, with a wooden shaft and an iron head, the latter of which was about one third of the length of the whole. The pilum was sometimes used at close quarters both as an offensive weapon and as a means of parrying blows, but more commonly it was thrown along with the other javelin, which every Roman spearman (hastarius) carried when within 10 or 15 paces of the enemy. The pilum, when thrown from this distance, would fix itself in the enemy's shield, whereupon the Romans would rush up, and seizing hold of the shafts of their pila draw down the shields in which they were fixed, and follow up the attack with their swords. In addition to the large engines of war that have been already mentioned as of Assyrian origin (scythe-chariots, catapults, and ballistæ) the Romans made use of battering-rams for making breaches in the walls of fortified places. The Greeks are said to have used a sort of cannon made on the principle of the modern air-gun. The Romans also employed caltrops to embarrass the movements of an enemy's cavalry.

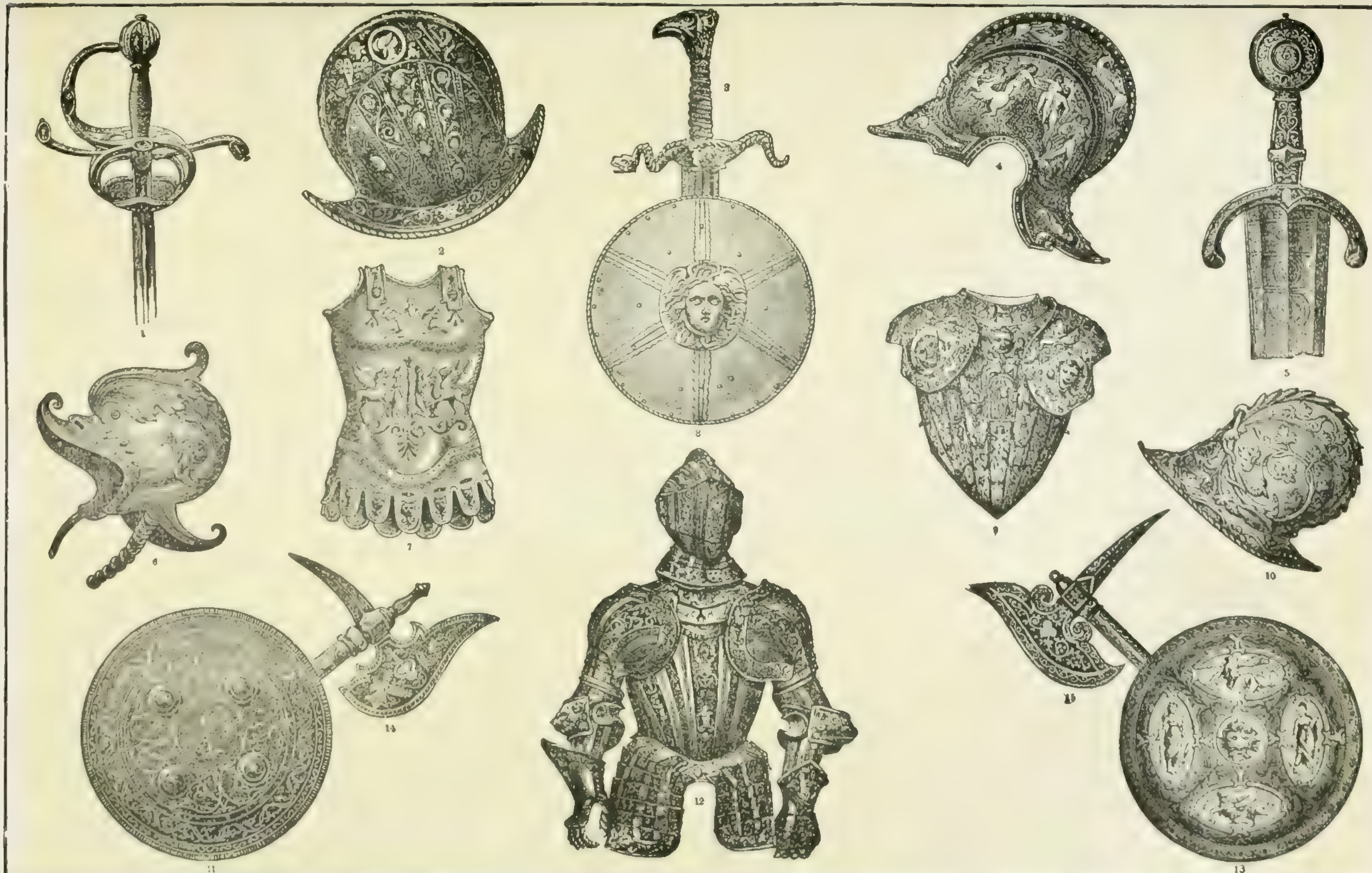
The principal pieces of defensive armor used by the ancients were shields, helmets, cuirasses, and greaves. No shields were carried by the Egyptian archers; but the Egyptian spearmen had large shields, rectangular below and semicircular at the top, and with a round sight-hole in this semicircular part. In the heroic age of Greece the shield is described as of immense size, so as to be capable of defending the whole body. In the early monuments the shield is still large, though not so large as it appears to have been in the heroic age. In shape it is round or oval, with a very considerable degree of convexity. At the time of the Peloponnesian war a still smaller shield came into use. The Romans had two sorts of shields — the *scutum,* a large, oblong, rectangular, highly convex shield, carried by the legionaries — and the *parma,* a small, round or oval, flat shield, carried by the light-armed troops and the cavalry. In the declining days of Rome the shields became larger and more varied in form. The helmet was a characteristic piece of armor among the Assyrians, Greeks, Etruscans, and Romans. Like all other body armor it was usually made of bronze. The Assyrian helmet was frequently conical. Sometimes it had the form of a truncated cone, and sometimes the pointed extremity was curved forward. The helmet of the historical age of Greece was distinguished by its lofty crest, which tapered downward to the back of the neck. The Etruscan helmet was also very high crested and sometimes had a wing rising to a considerable height on either side from points near the summit. The Roman helmet in the time of the early emperors fitted close to the head and had a hollow neck-guard and hinged cheek-pieces fastened under the chin, and a small bar across the face for a visor. The neck-guard and cheek-pieces were not peculiar to the Roman helmet, but were in common use wherever the helmet was worn. In later days the helmet of the Romans had a higher crown than that of the early emperors. The cuirasses of the Assyrians were close-fitting tunics made of several layers of flax plaited or interwoven and glued together. This kind of cuirass was introduced into Greece during the Peloponnesian war and was sometimes used even by the Romans. Before the Peloponnesian war the Greeks had the upper part of their body defended by bronze cuirasses. The defensive body armor of the Egyptian archers consisted of a quilted coat. The Egyptian spearmen had cuirasses of bronze scales or quilted with bands of metal. Under the Roman republic all the legionaries wore a bronze cuirass, consisting of a breast and back plate, with a border of pendent leather straps defending the lower part of the body. On the columns of Trajan and Antonine this cuirass is given only to officers, the legionaries wearing at that period only leather or linen cuirasses, on which circular plates of metal and metal shoulder-pieces were sewed, and to the lower border of which were attached oblong plates which served the purpose of the leather straps of the other cuirass. In the time of Trajan and Septimius Severus a flexible cuirass was added to the equipment of the Roman knight or horseman. This was made either of scales (*lorica squamata*) or of chains (*lorica hamata*). One of the latter kind has been found at Avenches in Switzerland, and is there exhibited. Greaves do not seem to have been worn by any of the eastern nations except the Persians, whose defensive armor resembled pretty closely that of the Middle Ages. The greaves of the Greeks (*knēmides*) were made in two pieces which were fastened together by clasps. The Roman greaves (*ocreæ*) were made in one piece and were often worn only on one leg. The Samnite practice was to wear the greave upon the left leg, which is the leg advanced in fighting with a shield on the left arm; but Vegetius mentions that the greave was worn by the Roman legionaries upon the right leg. The greave reached only from the knee to the ankle. The Roman soldiers had their feet protected by shoes set with nails (*caligæ*).

The favorite weapons of the Germanic races, by which the ancient civilization of Rome was to a large extent overthrown, were the battle-axe, the lance or dart, and the sword. Their defensive armor consisted almost exclusively of a shield made of plaited osier covered with leather and generally 8 feet by 2 in size. Afterward it was made round and bound with iron, and had several prominent bosses on its surface. The Frankish form of the German battle-axe was called *francisca* (francisque), and was the characteristic weapon of that tribe. It had a broad single-edged blade and a short haft, and was often used as a missile. The lance or dart of the Franks, called *angon,* closely resembled and was used exactly in the same way as the Roman pilum. The sword among the Franks was only a horseman's weapon. The shield of the Franks was round. Hardly any body armor (scarcely even a helmet) was used by them until the Carlovingian days. Swords belonging to the early iron age in Scandinavia are frequently found in the mosses of Schleswig. They are long, straight, two-edged, and often richly damascened. Shields belonging to the same district and epoch were made of wood, and were flat, round, and from 22½ to 44 inches in diameter. They were bossed and otherwise mounted, generally in bronze, sometimes in iron. The common arms of the Anglo-Saxon infantry were a spear, an axe, and a scramasax (a heavy single-edged knife). With the Anglo-Saxons as with the Franks the sword was especially a horse-

ARMOR.

1. French Foot Soldier, Eighth Century.
2. Polish Knight, end of Fifteenth Century.
3. French Soldier, about 1120 A. D.
4. Battle of Askalon (1099) from a Window in the Church of St. Louis, Paris.

5-6. German Full Armor, of the time of Maximilian I.
A. Mottled or Striped Armor. B. Ringed Armor. C. Fettered Armor. D. Shield Ornament. E. Plate Armor. F. Chain Armor.



1. Riding Sword, Seventeenth Century.
2. Morion of Italian work, Sixteenth Century.
3. Sword Hilt, Sixteenth Century.
4. Helmet of Philip II. of Spain: Italian work of Sixteenth Century
5. Sword Hilt of Cæsar Borgia.
6. Gold Damascened Helmet of Sixteenth Century
7. **Roman Body Armor.**
8. Shield of Sixteenth Century.
9. Breastplate of Philip III. of Spain.
10. Casque, Sixteenth Century.
11. Oriental Round Shield.
12. Body Armor, with Burgundian Head-piece, Sixteenth Century.
13. Shield of time of Henry II. of France.

14–15. Battle Axes of Sixteenth Century.

man's weapon, being carried by none under the rank of thane. The sword carried by them was 3 feet long, broad in the blade, and round at the point. The Saxon shield was round or oval, made of wood covered with leather, and furnished with a high conical boss.

The arms and armor both of the Normans and Anglo-Saxons, but especially of the former, at the time of the Norman conquest of England are pretty fully illustrated by the Bayeux tapestry. On this work the horsemen appear armed with long lances as well as swords. The Normans are represented as well furnished with archers and cavalry, of which arms the Saxons do not seem to have had any. Maces, clubs, axes with shafts from 4 to 5 feet long, are seen in the hands of both. The shields are long, rounded above and tapering to a point at the bottom. The body-armor consists of a long hauberk ringed or trellised. The helmet is conical and has a sort of tongue in front which comes down over the nose.

Chain armor of interlinked rings came into use at the time of the Crusades and continued in use till the beginning of the 14th century. From the latter date to early in the 15th century mixed chain and plate armor was in use, and from about the year 1410 to the beginning of the next century the body armor was entirely of plate, and complete suits of plate armor did not altogether go out of use for another century. Below the waist the body was protected by taces, a series of narrow overlapping plates attached to a lining of leather. After the introduction of complete suits of plate armor the chief modifications consisted in the strengthening of the weakest parts, especially on the right side. By the end of the 15th century plate armor had attained its highest development, even the horses at that period being protected by plate armor everywhere except on the legs. By this time, in fact, the fabrication of armor had reached such a degree of perfection that it was scarcely possible for men-at-arms engaged in combat to find any spot where the armor of their antagonist could be pierced. Combatants equipped in this manner aimed accordingly less at wounding than at unhorsing one another, for a man-at-arms unhorsed was at the mercy of his antagonist, who, if he could not find any weak point where he could pierce the armor of his fallen foe, might beat him to death with the heavy mace with which he was armed. Many savage encounters of this nature are recorded by the chroniclers of the time. Usually, however, a man-at-arms when unhorsed became the prisoner of his conqueror, and many battles were decided, especially in the wars between the states of Italy, carried on by means of mercenaries, almost or altogether without the shedding of blood either on the side of the vanquisher or the vanquished. When body-armor had come to be manufactured with such perfection shields were almost entirely discarded. In England, indeed, no effigy has been found representing a man-at-arms bearing a shield of later date than the last quarter of the 14th century, from which it would seem that that defense had gone out of use even before the adoption of complete suits of plate armor. Perhaps the most characteristic portion of the body-armor of the 15th century was that which protected the feet. The coverings for the feet during this period were laminated *sollerets* (as they were called), acutely pointed or rounded off at the toes. In the following century these were succeeded by *sabbatons,* cut off square at the toes. In this century the armor gradually became less rigid and cumbrous, and often consisted of small plates of metal quilted within linen or other tissues. As the century advanced the manufacture of body-armor declined, and after the close of the century armor was worn as much for show as for real service. Metal cuirasses gave place, as a rule, to buff suits and jerkins, although the former armor is not entirely disused even at the present day. The principal weapons of the man-at-arms were the lance, sword, battle-axe, and mace, all of which were remarkable for their massiveness, as might be expected from the resistance they had to meet. The lance (see LANCE and TOURNAMENT) was the weapon which he used to unhorse his antagonist if he could not wound him with it. Two-handed swords were in common use in the 16th century. The sword-breaker, consisting of a deeply notched blade about 15 inches in length, and intended to catch and break the sword of an antagonist, belongs to the same period.

During all the time that the use of heavy armor prevailed, the horsemen, who alone were so armed, formed the principal strength of armies; and so much was this the case that infantry were generally regarded as of hardly any account. An exception must, however, be made in the case of England, the archers of which were almost at all times, before the invention of gunpowder, an important and sometimes the chief force in the army. It has been already mentioned that the Bayeux tapestry furnishes us with evidence of the fact that the Normans were provided with archers at the time of the conquest. The bows used by them were small, being little more than a yard in length. The deadly weapon afterward used by the English archers was from 5 to 6 feet in length, and the arrow discharged from it was itself a yard long. The bow used in Germany as well as that used in Italy (where steel was the material of which it was usually made) was about a yard and a half long. There is no evidence of the cross-bow having been used before the 11th century. Its use against Christians was forbidden by the Council of the Lateran in 1139. The long-bow continued in general use in England till the end of the reign of Elizabeth, and even as late as 1627 there was a body of English archers in the pay of Richelieu at the siege of La Rochelle. The cross-bow did not go out of use in the French army till the 17th century. Among the other hand-arms in use before the invention of gunpowder were the sling and the fustibale, which was nothing else than a sling with a handle to it. The large engines of war used in the Middle Ages were the same as those that had been employed by the Romans, with only slight modifications. A coat made of leather or quilted stuff, called in French *gamboison* or *gambeson,* was almost the only defensive armor of the foot-soldier during the greater part of the period of which we are now treating.

The use of gunpowder as a means of discharging projectiles and the gradual improvement of firearms effected in course of time a

complete change in all the methods and accessories of warfare. Details regarding the construction and recent improvements of large and small firearms and projectiles will be found under BOMB, BULLET, CANNON, GUN, MUSKET, RIFLE, SHELL, etc. Gunpowder was not used in Europe to discharge projectiles till the beginning of the 14th century. Cannon are first mentioned in England in 1338, and there seems no doubt that they were used by the English at the siege of Cambrai in 1339. All early cannon were breech-loaders. In the oldest form the breech consists of wedges of wood or metal, and this form was succeeded by cannons with movable breech-piece. The projectiles first used for cannon were of stone. Field-guns were introduced in the course of the 15th century. A rifled cannon of the 15th century is to be seen in the museum of The Hague. Mortars were introduced into the French army in 1634. Hand firearms date from the 15th century. The Swiss at the battle of Morat in 1476 are said to have been provided with 6,000 arms of this kind. In England the yeomen of the guard were armed with them in 1485. At first they required two men to serve them, and it was necessary to rest the muzzle on a stand in aiming and firing. Lighter hand-firearms called petronels seem to have been first used by cavalry. Hand-firearms were at first fired in the same way as cannon, by means of a slow match carried in the hand and applied to the powder at the touchhole. The first improvement was the invention of the matchlock about 1476. In the matchlock the slow match was held at the end of one arm of a bent lever attached to the side of the piece in such a manner that by the action of a trigger it could be brought down upon the powder in the pan at the touchhole. This kind of lock was superseded by two others, the wheel-lock and the snaphance, that seem to have been invented about the same time early in the 16th century, although the matchlock contined in use long after that date, and indeed was not altogether abandoned till the beginning of the 18th century. The wheel-lock is generally said to have been invented at Nürnberg, and was largely used in Germany. It consisted of a steel wheel which was made to revolve by a spring, and in revolving struck fire from a flint, and at the same time lifted a cap which kept the powder in the pan from being wet by rain or blown away by the wind. The chief objection to it was that it was slow in its operation, as the spring had to be wound up every time it was used. The snaphance was largely used in the Spanish dominions. It was the immediate predecessor of the flintlock, from which it differed only in making the flint strike against a fixed upright piece of iron in front of the powder-pan, while in the flintlock this upright piece was attached to another piece that covered the pan and which turned on a hinge, so that when the flint descended and struck sparks from the iron it at the same time uncovered the pan. The flintlock was invented in France about 1640, and gradually came into universal use, until it was itself superseded by the percussion-lock. This last was patented by a Scotch clergyman named Alexander Forsyth in 1807, and had been adopted everywhere by the year 1820. The first model of the needle-gun was made in 1827 by J. N. Dreyse of Erfurt. It was first made breech-loading in 1836. The only important weapon not a firearm that has been invented since the introduction of gunpowder is the bayonet, which is believed to have been invented about 1650. The socket-bayonet, fitted round the muzzle of the gun, was introduced into the French army by Vauban.

The earliest collection of arms and armor was that made by Louis XII. at Amboise in 1502. There is a fine collection at Dresden, begun in 1553. Among others may be mentioned the Ambras collection, commenced in 1570, now at Vienna, and those at Turin, Sigmaringen, Tsarsko-selo, St. Petersburg, Madrid, and in the Tower of London. The last mentioned was classified by Dr. Meyrick, and catalogued by J. Hewitt. The Antiquarian Museum of Edinburgh is rich in weapons of the stone and bronze periods, but has few specimens of arms and armor of more modern times. Of works specially devoted to the subject of arms and armor the most worthy of mention are: Grose, 'Treatise on Ancient Armor and Weapons' (1785–6; Supp. 1789; afterward annexed to the second edition of the same author's 'Military Antiquities,' 1801), and Meyrick's 'Critical Inquiry into Ancient Armor as it existed in Europe, but particularly in England, from the Norman Conquest to the reign of King Charles II.' (1824). An excellent compendium on the subject by Auguste Demmin was published in 1869 in French, English, and German. The title of the English edition is 'Weapons of War'; it gives a history of arms and armor from the earliest period to the present time. See ARMAMENT OF THE WORLD.

Arms, Stand of, the outfit of arms necessary for the equipment of a single soldier.

Armstead, Henry Hugh, a noted English sculptor: b. in 1828. He executed many allegorical groups on the Albert Memorial, London, and several fine recumbent effigies in Westminster Abbey.

Arm'strong, Sir Alexander, an English physician: b. in Ireland about 1820; d. 5 July 1899. He was educated at Trinity College, Dublin, and at the University of Edinburgh; and became widely known as an explorer. Entering the British navy at an early age, he served in many parts of the world, took part in an expedition to Xanthus in Syria; spent five consecutive years in the Arctic regions, searching for Sir John Franklin; and circumnavigated the American continent, in which voyage he became one of the discoverers of the Northwest Passage. For several years he was director-general of the medical department of the British navy. His publications include 'A Personal Narrative of the Discovery of the Northwest Passage,' and 'Observations on Naval Hygiene, Particularly in Connection with Polar Service.'

Arm'strong, David Maitland, an American genre and decorative artist: b. near Newburg, N. Y., 12 June 1837. He was graduated from Trinity College, Hartford, Conn., in 1858; practised law a few years, and then studied art in Paris and Rome. He was United States consul-general for Italy for four years, and director of the American Art Department at the Paris Exposition in 1878, receiving the Legion of Honor

decoration for his services. For many years he was at the head of a decorative glass establishment in New York city.

Armstrong, George, called the «Father of the United States Railway Mail Service»: b. Armagh, Ireland, 27 Oct. 1822; d. Chicago 5 May 1871. His parents came to the United States when he was eight years old and settled in Baltimore. He entered the postal service in Washington when a young man, and his ability won him promotion in 1854 to assistant postmaster at Chicago. He then made a study of mail transportation, wrote exhaustively on the subject, and in July 1864 was given authority by Postmaster-General Montgomery Blair to experiment on any railroad he might select. The first trial took place on the Northwestern Railroad 28 Aug. 1864, between Chicago and Clinton, Iowa, and was a complete success. He was the head of the service from the start but was assigned to headquarters in the West, with general supervision of the service in the East. In 1869 President Grant directed that a bureau be made of the railway postal service, and placed Armstrong at the head as general superintendent, a position which he held until his death two years later. A bronze statue in memory of his work was erected in the post-office building, Chicago, in May 1881. See POSTAL SERVICE IN COMMERCE.

Arm'strong, John, an American author and soldier: b. Carlisle, Pa., 25 Nov. 1758; d. Red Hook, N. Y., 1 April 1843. He served in the War of the Revolution on the staff of Gen. Gates. He was United States minister to France, 1804–10, and afterward to Spain; and secretary of war, 1813–14. He wrote the 'Newburg Addresses' in 1783, anonymously, with the intent to arouse Congress to redress army grievances. He also wrote 'Notices of the War of 1812' (1836).

Arm'strong, Samuel Chapman, an American educator: b. Wailuku, Maui, Hawaii, 30 Jan. 1839; d. Hampton, Va., 11 May 1893. He was a son of Richard Armstrong, one of the earliest American missionaries to Hawaiian Islands and founder of their educational system. The son was educated at Oahu College, Honolulu, till 1860, and graduating from Williams College in 1862, at once entered the Union army. He served till the end of the Civil War and was mustered out with the rank of brigadier-general of volunteers. In 1866 Gen. O. O. Howard, who had noted Armstrong's interest in the colored troops, induced him to take a position with the Freedman's Bureau, where he was charged with the oversight of all colored people in 10 Virginia counties. After two years of successful administration, during which he had worked out a careful plan of negro education, he enlisted the aid of the American Missionary Association and personal friends in the North, and founded the Hampton Normal and Agricultural Institute. Its object was to give the negroes practical education, to train teachers, and to render its graduates self-supporting. For 10 years the students were negroes exclusively; then (1878) the United States government, attracted by Armstrong's success, arranged to have Indian children taught there. This experiment has also proved successful. Gen. Armstrong devoted his life to the school and made it the best known and studied one of its kind in the world. At his death it had 100 teachers and employees, 200 Indian and 600 colored students.

Arm'strong, William George, Baron, an English engineer and mechanical inventor: b. Newcastle-on-Tyne, 10 Nov. 1810; d. 27 Nov. 1900. He was trained as a solicitor, and practised as such for some time, though his tastes scarcely lay in that direction. Among his early inventions were the hydro-electric machine, a powerful apparatus for producing frictional electricity, and the hydraulic crane. In 1847 the Elswick works, near Newcastle, were established for the manufacture of his cranes and other heavy iron machinery, and these works are now among the most extensive of their kind. Here the first rifled ordnance gun which bears his name was made in 1854. (See ARMSTRONG GUN.) His improvements in the manufacture of guns and shells led to his being appointed engineer of rifled ordnance under government, and he was knighted in 1858. This appointment came to an end in 1863, since which time his ordnance has taken a prominent place in the armaments of different countries. He was raised to the peerage as Baron Armstrong in 1887.

Arm'strong Gun, a description of rifled cannon, named from its inventor, the late Baron Armstrong. It is constructed of small pieces of the very best wrought-iron in the following manner: Bars of wrought-iron, having a width of 2 inches, are raised to a white heat and then twisted round a steel bar or core, and other bars are twisted successively over these till the requisite degree of thickness and strength is obtained. The various layers of bars are then firmly welded together at a white heat by the steam-hammer. Two of these welded pieces, each of them having a length of three feet, are trimmed and adjusted at the ends, which are brought close together, and united by a ring of wrought-iron, bound round them at a white heat. The length of the gun may be increased by lengthening or adding to the number of welded pieces. The steel bar which formed the core of the gun is now removed, and the sides of the bore rifled with upward of 40 small close grooves. The advantages secured by the Armstrong gun were at once manifest as of the highest importance. Its range exceeded 9,000 yards, or upward of 5 miles, being about three times the extent of that of an old-type cannon. Its precision of firing is also remarkable; and a target 9 feet square, placed at distance of 4,000 yards, has been hit 90 times in 100. At 1,000 yards' distance an Armstrong gun has hit every time an object which, aimed at by the same gunner with an old 32-pounder, has been missed 56 times out of 57. Another great advantage possessed by this description of gun is its lightness, an ordinary 32-pounder weighing 56 hundredweight, while Armstrong's 32-pounder weighs only 20 hundredweight. Lastly, the charge of powder required is only about half the quantity necessary for an ordinary cannon, and the number of times which the piece may be discharged without exhibiting any injury far exceeded anything recorded in the history of gunnery down to the time of its invention. See ORDNANCE.

Ar'my. Among nations of antiquity all men capable of bearing arms were liable to be called on to serve as soldiers, with the exception of the Egyptians, Indians of Aryan race, and Israelites. In the first two of these nations the warrior formed a separate class or caste of the community, ranking next in dignity and influence to that of the priests. In Egypt the military caste shared with the king and the priests the whole of the soil. The members of the caste were interdicted from all handicrafts. The Egyptian infantry was mainly composed of archers. Foreign auxiliaries were also employed, but kept in a strictly subordinate position, except under the last native kings of Egypt; and the different policy pursued by them was without doubt in a great measure to blame for the easy conquest of Egypt by Cambyses. In India the members of the warrior caste were called Kshatriyas, and after the complete subjugation of the non-Aryan inhabitants whom they found in the peninsula when it was invaded by them, seem generally to have lived an indolent life. Among the Israelites the only portion of the male population exempt from military service was of the tribe of Levi. In the other tribes all men above 20 might be called upon to serve in the army when occasion required. At first the army of the Israelites consisted entirely of infantry. David introduced charioteers, and Solomon added a regiment of cavalry. In later times an Egyptian auxiliary cavalry is sometimes found serving in the Jewish armies. The beginning of a standing army was made by Saul, who raised a body-guard of 3,000 men. After the captivity a new organization developed itself under the Maccabees. John Hyrcanus raised an army of foreign soldiers, chiefly Arabs.

From the monuments found in the valleys of the Euphrates and the Tigris we learn that at an early date the Assyrians, Babylonians, and Medes possessed armies of infantry, cavalry, and charioteers, and divided into light and heavy armed troops, distinguished by dress, equipment, and arms. But it was after the establishment of the Persian empire that the army system of the East attained its highest point of development. When the Persians had extended their empire over almost the whole of western Asia it was necessary to maintain a standing army to keep down conquered tribes and to guard the frontiers. The various sections of this army were each levied in the province to which it belonged, and were partly stationed in fortified towns, partly distributed over the country districts. Their pay was derived from the revenues of the province, but their commanders were wholly independent of the satraps or provincial governors. Yearly reviews were held in order to see that they were constantly kept in a state of efficiency. The troops of the standing army included a light and a heavy infantry, as well as strong bodies of cavalry, part of whom were clad in armor. The subdivisions of the army (both cavalry and infantry) were according to the decimal system. Originally all the forces were Persians, but in later times Asiatics and Greeks were also enrolled. Express messengers, stationed throughout the empire at the distance of a day's journey from one another, formed the means of communication between the different parts of the army. In addition to this provincial force the king had a body-guard of 10,000 men, called the immortals, from the fact that their numbers were always kept full. When great expeditions (such as the invasions of Greece) were undertaken a levy of the whole people was made. Fifty-six nations, according to Herodotus, were represented in the levy made by Xerxes for his celebrated Greek expedition.

In the small free states of Greece the armies consisted of a civic militia, in which it was the right and duty of every freeman to serve. In times of emergency the slaves also were armed. The Greek armies often consisted exclusively of infantry. Athens never had more than 1,000 cavalry. The foot soldiers were divided into *hoplitai*, or heavy-armed, whose equipments consisted of a long lance, a sword, and a large shield; *peltastai*, armed with a short spear, and carrying a small round shield; *psiloi*, carrying no shields, and armed only with javelins, bows and arrows, or slings; and *gymnētes*, also without shields, and chiefly composed of slaves and foreigners. The age for military service was 20 to 40 at Athens and 20 to 60 at Sparta. In Athens, however, every youth was enrolled at the age of 18, although not liable to be called on for active service till he had reached the age of 20. The command of the Athenian army was divided between 10 generals, who were elected for one year, one by each of the 10 Attic tribes, and each of whom had the chief command in turn for one day, when they were all present with the army. To obviate the manifest inconvenience of this arrangement nine of the generals were sometimes left behind, and sometimes one of the archons called the Polemarch took the field, in which case the duties of a commander-in-chief were in a great measure left to him. Until after the Peloponnesian war Athenian soldiers received no pay, but from that date a small pay was given to those in the field. At Sparta the command of the army belonged to the two kings, and usually two armies were formed, each king having the command of one of them. When only one army was formed one of the kings remained at home. Although in Sparta, as in Athens, the army consisted of the free citizens generally, yet, as in the former city it was always kept ready for war, it constituted a kind of standing army. It was divided into five *moras* or regiments, one for each tribe. After the time of the Peloponnesian war it became more and more common for all the Greek states to employ mercenary troops, and the Greeks themselves often entered into foreign service. The Macedonian standing army was created by Philip, and from the time of Alexander was composed chiefly of mercenaries. The Carthaginian armies consisted in large part, and indeed mainly, of mercenaries. The body-guard of the general, called the "sacred band," was, however, entirely made up of Carthaginians by birth, but was distinguished less by its valor than by the splendor of its equipments. In the army of Hannibal, Gauls, Iberians, and Ligurians formed the main force; Numidian cavalry hovered on the wings; Balearic slingers and elephants led by Ethiopian masters were drawn up in front. In Rome every citizen from the age of 17 to 46 was bound to serve in the army till he had made 16 (or in emergencies 20) campaigns on foot or 10 in the cavalry, and no citizen could become a candidate for any magiste-

rial office unless he had been 10 years on foot or 5 mounted. During the best times of the Roman army the troops were selected with great care, and the discipline and training of the legions were admirable, so that the Roman infantry (of which the legions were mainly composed) was the best the world had yet seen. The Roman cavalry, on the other hand, was numerically weak, and was excelled by the Numidian, and still more so by the Parthian. Pay was given to the Roman troops from the time of the siege of Veii (406 B.C.). When the Roman empire in the West fell to pieces, in consequence of the repeated inroads and settlement within its borders of German tribes, there was an end for the time to all regular army organization in western Europe. The forces by means of which the Roman empire had been gradually dismembered consisted, like the Persian hordes that 1,000 years before had conquered western Asia, of armed nations; but a new military organization, greatly inferior, however, to that of the Romans, grew up in process of time out of an institution common to all the German tribes. This was the practice followed by the chiefs of gathering round themselves bodies of retainers constantly ready to fight under them, in the expectation of being rewarded out of the spoils of conquest. As long as the Germans were confined to their original settlements outside the Roman empire these bodies of retainers bore a small proportion to the total strength of the armed population; but when extensive conquests of land were made within the Roman empire more or less of the conquered territory was always seized by the conquerors, and the personal retainers of the conquering chiefs were often so richly rewarded that the retinues of the chiefs were rapidly swelled by the adhesion of those who hoped for equal gain. At first these grants were looked upon simply as rewards for past services, but they soon came to be given and received as pledges of future service, every person receiving a grant being bound to serve his chief in war whenever called upon. In this way the feudal system, as it is called, gradually arose, and feudal armies finally superseded the national levies of the German tribes. When Charles Martel conquered the Saracens at Tours in 732 the transition from national to feudal armies was not yet accomplished, but it was almost completed under Charlemagne at the end of the same century. The chief strength of the feudal armies lay in the men-at-arms, who were all mounted, heavily armed, and protected by shields and defensive armor. After the introduction of firearms, shields and armor ceased to be an effectual protection, personal valor and bodily strength became of less moment, disciplined armies were found to be necessary, and the knights entered these armies as officers. The military forces of the small states that rose up in Italy from the 12th century resembled those of the states of ancient Greece in being at first nothing more than a civic militia. In later times hardly any troops were used, but mercenaries were employed, led by *condottieri*, and these at last were superseded by standing armies.

Among the countries of modern Europe the foundation of a standing army was first laid in France. In 1439 Charles VII. of France issued an ordinance called the ordinance of Orleans for the creation of a number of troops of horse (hence called *compagnies d'ordonnance* or ordinance companies), which were to be maintained by the cities and villages in war and peace. In 1448 the same king established a corresponding body of infantry called *Francs-archers*. Henceforward the feudal militia fell more and more into disrepute, and the vassals assembled their forces only on occasions of great emergency. The example of France was followed elsewhere, and during the wars of Francis I. and Charles V. at the beginning of the 16th century, France, Germany, and Spain were all in possession of considerable standing armies. These armies were all raised mainly by voluntary enlistment, compulsory levies being resorted to only under the pressure of exceptional circumstances. The usual practice was for the king to contract with some nobleman or gentleman for the raising of a regiment; but in the Thirty Years' war Gustavus Adolphus set the example of raising all his troops directly for his own service. In this same war, however, a whole army was raised for the emperor by a private gentleman (the celebrated Wallenstein), the emperor engaging to give him the command of it. Gustavus Adolphus was also the author of many reforms in army organization. He established smaller divisions, introduced lighter weapons, separated the pikemen from the musketeers, who had hitherto been mixed together, and made many improvements in the artillery; by all of which changes quicker and more complicated movements became practicable. The soldier was more thoroughly drilled and reduced almost to a machine, while the responsibilities of the officers were increased. The wars of Louis XIV. led to further improvements in military organization and tactics, and in a still greater degree to the increase of the size of armies. Instead of the 14,000 men maintained by Henry IV. of France, Louis XIV., after the Peace of Nijmegen (1678) had on foot an army of 140,000 men. Armies were likewise increased by all the other powers of Europe except England and Holland, where the strengthening of the standing army was looked on with great jealousy, and till the time of William III. continually opposed by the representatives of the people as dangerous to freedom. Among the military powers that came to the front in the next century the new Prussian monarchy was perhaps the most conspicuous. Frederick William I. devoted all his energies to the creation of a strong military force, and his army of 80,000 was increased by Frederick II. to 200,000. The latter introduced the system which still prevails in Prussia, and is now extended to the whole German empire, of localizing the different sections of his army. Each regiment was assigned to a certain district, which was bound to keep it at its full complement. Where voluntary enlistment did not suffice for this purpose resort was had to conscription; but this was applied only to the lowest classes of the community. The systems of drill now followed in all European armies are founded on that introduced into the Prussian army by Leopold of Dessau, who organized it under Frederick William I. Cavalry tactics were greatly improved by Frederick the Great himself, who also was the first to use horse artillery. The dividing of artillery into batteries is of about the same

date, but is due to a Frenchman named Gribeauval.

Since the time of Frederick the Great a great change has taken place in the composition of armies through the reintroduction of the principle of the universal liability of all men capable of bearing arms to military service, or, in other words, through the raising of armies by a general conscription, now practised in every European country except England. Conscription was first adopted by France in 1798, and it was by means of it that Napoleon was able to raise the large armies with which he overran and conquered a great part of the Continent. In 1808 it was adopted by Prussia, by which power it has been applied with greater rigor than by any other. In Prussia it was combined with the short-service system, a mode of training the population to arms suggested by Napoleon's attempt in the Peace of Tilsit to limit the Prussian army to a certain strength. This system consists in requiring those serving in the active army to remain under arms for a comparatively short term (in Prussia three years), during which they become thoroughly trained soldiers ready for active service on any emergency. Every year a certain number return from the army to civil life, and are replaced by others who are subjected to military training for the same term. By this means Prussia, while never maintaining a larger active army than that prescribed by the Peace of Tilsit, was able to train its whole able-bodied male population to arms, and that without allowing the fact to be discovered until it was made manifest by the war of revenge in 1813. In other countries where the principle of conscription had been adopted its operation was greatly weakened by the numerous exemptions that might be obtained, and especially by allowing those required to serve to obtain exemption by paying for a substitute. Especially was this the case in France, where, under Napoleon III., the army had again become to all intents and purposes a professional one. In army organization the principal change that has been made since the introduction of conscription has been the establishment of army corps (*corps d'armée*), that is, divisions of an army composed of all arms (infantry, cavalry, and artillery), and placed under the command of a single general. These divisions were first established by Napoleon, who placed them under the command of his marshals. The division was afterward adopted by Prussia and extended to the German empire, where the further improvement is made of localizing each army corps in a certain province or member of the empire, in which it is reunited, and in which are kept all the arms and other equipments necessary for its mobilization. In the Prussian army the cavalry are very numerous, and are used principally on the march, when they are sent in front to cover the advance of the main body of the troops, and to collect information. In all armies considerable changes in tactics have resulted from the increased range, precision, and rapidity of fire of the improved artillery and musketry now in use.

In most nations, will now be found an army of reserve, intended to augment the standing army from a peace to a war strength, and consisting of two classes — those waiting an immediate call to arms, if required, and those constituting the militia — the entire effective military power of the state. It may be of interest here to mention certain distinctions in the application of the word army. A covering army is encamped for the protection of the different passes or roads which lead to the town or other place to be protected. A siege army is ranged around or in front of a fortified place, to capture it by a regular process of besieging. A blockading army, either independent of, or auxiliary to, a siege army, is intended to prevent all ingress and egress at the streets or gates of a besieged place. An army of observation takes up an advanced position, and by celerity of movement keeps a close watch on all the manœuvres of the enemy. An army of reconnaissance has a more special duty at a particular time and place, to ascertain the strength and position of the enemy's forces. A flying column is a small army carrying all its supplies with it, so as to be able to operate quickly and in any direction, independently of its original base of operations.

ARMIES OF THE WORLD.— The following table shows the armed strength of the military nations of the world as reported in 1900:

Argentine Republic.— Regular army, 945 officers and 312,073 men; national guard, 480,000 officers and men.

Austria-Hungary.— Peace footing, 24,583 officers and 333,628 men; war footing, 45,238 officers and 1,826,940 men; levy in mass, over 4,000,000.

Belgium.— Peace footing, 3,419 officers and 48,014 men; war footing, 4,466 officers and 143,628 men; Garde Civique, 42,827 officers and men.

Bolivia.— Peace footing, 1,021 officers and 2,000 men; war footing, 82,000 officers and men.

Brazil.— Peace footing, 4,000 officers and 24,160 men; gendarmerie, 20,000.

British Empire.— Regular army, 8,109 commissioned officers, 1,087 warrant officers, 17,100 sergeants, 3,941 musicians, and 150,267 rank and file; reserves, regular, first and second classes, 83,000 officers and men, militia, 138,961, yeomanry, 11,891, volunteers, 263,963; total home and colonial forces, 669,259; regular forces on Indian establishments, 73,162; grand total, 742,421 officers and men, of whom 664,189 were classed as effectives. Owing to the war in South Africa these numbers were increased considerably during the early part of the year.

Chile.— Regular army, 623 officers and 29,282 men; national guard, 512,700.

China.—The Eight Banners, about 300,000 officers and men; Ying Ping (national army) from 540,000 to 600,000 men; active armies of the Centre, Manchuria, and Turkestan, number unknown; total land army on peace footing about 300,000; on war footing, about 1,000,000.

Colombia.— Peace footing fixed at 1,000, in 1898; war footing fixed by Congress as circumstances may require.

Costa Rica.— Peace footing, 600 officers and men, and 12,000 militia; war footing, 34,000.

Denmark.— Peace footing, 800 officers and 9,000 men; war footing, 1,350 officers and 58,600 men.

Ecuador.— Peace footing, 3,341 officers and men; war footing, 30,000.

Egypt.— Regular, about 100 English officers

and 18,000 men. The English army of occupation numbers 5,553 officers and men.

France.— Peace footing, 26,849 officers and 520,666 men, with 140,912 horses; in Algeria, 2,195 officers and 55,122 men; in Tunis, 560 officers and 13,455 men. Active army and its reserve, 2,350,000; territorial army, 900,000; territorial reserve, 1,100,000; total, 4,350,000 men of whom about 2,500,000 were effectives.

German Empire.— Peace footing, 23,176 officers and 562,277 men, with 98,038 horses; war footing, strength not officially published, but estimated at over 3,000,000 trained officers and men. There are 494 field batteries, of which 47 are mounted.

Greece.— Peace footing, 1,880 officers and 23,453 men; war footing, about 82,000 men; territorial army, about 96,000 men.

Guatemala.— Peace footing, about 7,000 officers and men; war footing, 56,900 men.

Haiti.— Peace footing, 6,828 officers and men, and special guard of 10 officers and 650 men.

Honduras.— Peace footing, 500 officers and men; with 20,000 militia.

Italy.— Permanent army, under arms, 14,324 officers and 237,660 men; on unlimited leave, 556,984 officers and men; mobile militia, 475,972 officers and men; territorial militia, 10,793 officers and 2,003,474 men; total officers and men, 3,299,439.

Japan.— Imperial Guard, 370 officers and 10,843 men; 6 divisions, 2,745 officers and 73,606 men; reserves, 696 officers and 82,384 men; Yezo militia, 95 officers and 4,482 men; the gendarmerie, 51 officers and 1,011 men; territorial army, 357 officers and 104,597 men; total strength, 4,760 officers and 279,981 men, with about 29,000 horses.

Kongo Free State.— Peace footing, 234 European officers and 173 sergeants, and 15,580 native troops.

Korea.—An army of 5,000 officers and men.

Madagascar.—An army of 191 officers and 5,508 men.

Mexico.— Peace footing, 2,068 officers and 30,095 men; war footing, including reserves, 151,500 officers and men.

Montenegro.— No standing army; all males physically able are liable to military service; there are about 100,000 rifles in the country.

Morocco.— Peace footing, about 12,000 officers and men, and 18,000 militia; war footing, in addition, about 40,000.

Netherlands.— Peace footing, 1,466 officers and 40,195 sub-officers and soldiers; war footing, indefinite.

Nicaragua.— Peace footing, 2,000 officers and men; war footing, in addition, 10,000 reserve and national guard, 5,000.

Norway.—Troops of the line and reserves, 900 officers and 30,000 men; not over 18,000 troops can be put under arms, even in war, without consent of the Storthing.

Orange Free State.— Standing army, 150 officers and men, and 550 artillerymen, as a reserve; available war strength, 17,381.

Paraguay.— Standing army, 82 officers and 1,345 men; every male 20 to 35 years old is liable to war service.

Persia.— Standing army, 24,500; nominal, 105,500; liable to service, 53,520.

Peru.— Peace footing, 3,157 officers and men with a police force of from 2,000 to 3,000.

Portugal.— Peace footing, 35,337 officers and men; war footing, 160,000; colonial forces, 9,478 officers and men, the greater number being native troops.

Rumania.— Peace footing, 3,478 officers, 448 employees, and 56,489 men, 12,675 horses, and 390 guns; territorial army 75,000 men, and 8,050 horses; war footing, indefinite.

Russia.— Peace footing, 36,000 officers and 860,000 men; war footing, 63,000 officers and 3,440,000 men.

Salvador.— Standing army, 4,000 officers and men; militia, 18,000.

Santo Domingo.— Small army and reserve at the capital of each province, every physically able male liable to service.

Servia.— Standing army, 160,751 officers and men; war footing, 353,366 officers and men.

Siam.— Standing army, 12,000; no armed militia; all males liable for war service.

South African Republic.— No standing army; males liable for war service, 26,299.

Spain.— Peace footing, 128,559 officers and men; war footing, 183,972 officers and men.

Sweden.— Standing army, 1,946 officers and 37,175 men.

Switzerland.— No standing army; war effective, Elite, 147,191 officers and men; Landerwehr, 83,283; Landstrum, 271,780.

Turkey.— Standing army, 700,62c officers and men; war footing, 900,000.

United States. See ARMY OF UNITED STATES.

Uruguay.— Permanent army, 233 officers and 3,222 men; armed police force, 3,200; national guard, 20,000.

Venezuela.— Standing army, 3,600 officers and men; national militia (males 18 to 45 years old), 60,000 men.

Army and Navy, Mutual Relations of. The campaign of the United States army and navy in the Caribbean region, while instructive from many points of view, has especial value at the present moment to the people of the United States, as illustrative of certain necessary outlines of our future naval and military policy. Estimating at the lowest the permanent results of the late war, the nation finds itself charged with valuable transmarine possessions, which have not merely to receive the local defence which is — or should be — common to the country in general, but must also, for the welfare of the Commonwealth, be knit to the home body by the only military bonds that can cross the stretch of the seas. Local protection is indeed imperative; but from the military point of view, national defence, in any real sense, cannot be said to exist when the localized defences are not knit together and co-ordinated into a system, which insures freedom of communication and thereby mutual support. Gibraltar and its rock are the proverbial synonym of impregnability; yet Gibraltar in its time not only has fallen by local neglect, but has more than once narrowly escaped a like fate through inferiority of naval force — through severance of communications with the body of which it is a member.

The fortified places upon which a system of defence rests are stationary. They contribute to the general safety, directly, only so far as their guns can range, or as conducive to delay in case of attack; but when to them is added a mobile force, which either issues from them to assume the offensive, or which, in its move-

ments, in the open, knows that in them security can be found in case of reverse, the various members are brought into a living union, wherein each contributes its proportion to the strength of the whole. On land such mobile force is represented by the active army in the field; at sea by the fleet. Both need the support of stationary fortifications; and both, as has just been said, are essential in turn to the fortresses themselves. Jomini has truly said, "When a state depends wholly upon fortified places (that is, upon mere defence) for its safety, it has touched the verge of ruin." It may be deemed fortunate, that at the moment of starting upon a new career, the United States received an object lesson in the mutual relations of army and navy, of stationary defences to mobile force; a dramatic presentation of the part played by each, not only on the field of battle, but in the general maintenance of national security and power. Upon this living picture the eyes of the whole nation were fixed, with the vivid interest which always follows the progress of arms. The campaign against Cuba — and especially against Santiago — by sea and by land, has for us the particular value that it lies wholly within our own experience, and speaks to us therefore with the force which belongs to experience alone among the teachers of mankind.

It is wise, says an old proverb, to learn from one's enemy. Let us, for our instruction, turn our eyes for a moment upon our recent enemy, upon him who 400 years ago, in the heyday of Europe's adolescence, went forth, a youth among other youths, to possess the land, and who now returns a discomfited prodigal, abandoning the last of the fair heritage upon which he, favored above his fellows, then entered. It is not indeed admissible in a short article, dealing avowedly with a particular brief episode of history, to attempt to trace the general causes of Spain's downfall. Suffice it to note, in pursuance of our previous allegory, that from the beginning Spain's ideas, both individual and national, carried within them the seeds of inevitable and early blight. She shared with her contemporaries the restless ebullience of early manhood, as the nations were breaking out of the nursery of tradition and authority; but she went forth imbued, not with principles of action, but with mere habits of thought, externally imposed, and accepted without the self-questioning that comes from the collision of mind with mind. So, while the world was growing, Spain grew not. A century after America was discovered, she was in thought and method just where Ferdinand and Isabella were; as it is recommended to us now to remain just where Washington or Jefferson, under different conditions, stood 100 years ago. The colonial system of Spain, which gasped its last this year, continued essentially the same from the beginning to the end; even as we are told by foreigners familiar with the peninsula that people there live for the most part in the ideas of centuries ago. Shock after shock failed to loosen the hold of tradition, and it may be doubted whether even the final crash will penetrate through men's ears to the brain.

One thing Spain has never been since the time that the unity of the peninsula was achieved — a maritime nation. Seamen, doubtless, she has had; it would be rash indeed to deny that name to the men who accompanied Columbus, although the great adventurer was himself Italian; but for all that, as a nation, the heart of Spain has never turned to the sea. Yet Great Britain herself was scarcely more favorably situated for the development of maritime instincts and maritime power. Like France, Spain borders the Atlantic and the Mediterranean; but above France she possessed the advantage that her only land frontier (leaving little Portugal out of account) was a lofty and difficult mountain range. Like the United States of to-day, which borders the Atlantic and the Pacific, Spain was practically an insular power; for, unlike the United States in the days of Washington, she had no dangerous continental frontiers. In this security from attack by land, in the power of her sovereigns, unrivaled in the 16th century, in her remoteness from the turmoil of central Europe, and in the one single danger to which she was exposed — the ravaging of the coasts by the Mohammedan pirates — was found a combination of circumstances, which, so far as external pressure molds character, should have made Spain a respectable, if not a great, naval state. From the resources and exposure of her extensive and lucrative colonies there arose an additional incentive to commercial and naval development; but none followed. The root of the matter was not in her. What she was, that she remained. Often rebuked by disaster, she hardened herself against change; until, in the end, she has suddenly been destroyed, and that without remedy.

Yet no people more than the Spaniards understood and practised the art of fortification as it existed in the days of their power. It was not lack of local defences that enfeebled the colonial empire of Spain, and so often caused particular localities to fall before an invader. It was the lack of control over the communications — over the sea, by which alone communication could be had — which permitted the enemy to assemble his forces with impunity, and prevented the Spaniards from reinforcing where needed; in a word, it was defect in the sea power, which insures mutual support and the possibility of offensive action. Defence, whether greater or less, only imposes delay; and delay must be improved, or it is useless. Like a burglar at a safe, so is the besieger; except that interruption may come, the time more or less does not matter. The essential thing for the party who, as regards the war, is on the defensive — who has the most to lose — is to retain in his hands the power to move at will and rapidly from point to point; not merely to defend locally, but to attack the assailant either in transit, or at his point of destination; or, it may be, even by offensive operations on the enemy's own coasts. Such power — sea power — Spain has never had. The material elements she did indeed from time to time create. "I never saw finer ships," said Nelson a century ago. "The Dons make fine ships; they cannot, however, make men." This manifests again the impotence of mere government, or external compulsion, to impress upon man or people qualities which find within no root of life, native or implanted. In the inward realm of ideas, diffused among the people, is the true strength of nations to be found. May we heed the warning.

The history of four centuries only repeats itself in miniature when the final scene in the

long drama of Spain's colonial history is critically regarded. The last Cuban revolt had continued already three years when the United States intervened. During that period, Spain had sent over 200,000 soldiers to her colonies, and had incurred an extraordinary expenditure of some $400,000,000 for the campaigns; an immense effort, whether regarded in itself alone, or relatively to the resources of the mother-country. Yet, although the mutterings that ran throughout the United States were audible in Europe, and it could have been plainly recognized that behind a mere political bluster there was unquestionable popular impulse — a most dangerous condition — no important addition was made to the fleet. Even the vessels on hand, antiquated though some were, were not brought up to the full efficiency they might have received. Cervera sailed with but four ships. Not till six weeks later was Cámera able to get away, and then there went with him only two armored vessels. The inference is reasonable that such others as there were — and there were others — could not be got ready; that even the nominal force was not available. Yet one thing demonstrably certain is, that had the Spaniards maintained a navy superior to our own, the expense of which would have been far less than the cost of their troops in Cuba, it would have excluded us from the island, which otherwise its fortifications and armies could not do. It may be assumed, indeed, that had the Spanish navy been decisively superior to our own we would have refrained from war, unless determined to it by the loss of the Maine; for nothing so certainly maintains the peace as the evident readiness of the enemy. This the great armies of Europe now show. As it was, when Cervera was shut up in Santiago, we dared to send 15,000 men a thousand miles by sea, to land at the very mouth of the harbor; and after this squadron was destroyed we were quite at our ease as regards the rest of the task. Utterly undeveloped as our military preparations were, we could take our time. The Spanish force in Cuba must waste; ours could not but increase. The end was thenceforth predetermined, and Spain wisely asked for peace.

Yet while this lesson is clear, and in the opinion of the writer is the one of primary importance to ourselves — as to any nation undertaking to have colonies — it would be a most incomplete and misleading view did we not further recognize the complementary element of land forces and fortifications in deciding the issue of the war. Had there remained to Spain a fleet — a "fleet in being," to use a phrase now widely accepted as technical — at all equal to our own, and able shortly to get to sea, our advantage at Santiago would have been but momentary and indecisive. The presence of the Spanish army, 100,000 strong, of as good fighting quality as the Santiago garrison is said to have shown, while it would not have controlled the whole island, would have effectually excluded us from the more important part, until the Spanish navy, temporarily eliminated by Cervera's defeat, could have again been brought into play. The co-ordinate value of mere defence would have received conspicuous illustration. The Spanish army in Cuba, and its fortifications of every kind, seacoast or otherwise, were, as regards the general war, strictly limited to the defence of the island. The communications between it and the United States — the roads — were in our hands, to transport troops as we pleased; but only temporarily so, on the present hypothesis, namely, that Spain had still a fleet which, upon arrival in the Caribbean, would have a fighting equality or superiority to ours. The question therefore at such a stage would be one of delay. Can the Spanish army keep the field until its fleet appears and exclude us from the control of the vital centre of the island? Failing this, can it even, by retiring to its fortresses, preserve its integrity, and prevent our obtaining that essential foothold for maritime enterprise, a fortified seaport close to the scene of operation — a bridgehead for entrance when ready? If so, it secures the necessary delay until the all-important decisive factor in maritime wars, the navy, can make itself again felt.

It is clear, therefore, that while an incontestable and inalienable primacy belongs to the navy in all cases of transmarine warfare, the maintenance of an adequate territorial army, resting upon proper fortified bases, is likewise indispensable, if secondary. And indeed, this hypothetical case, of a fleet remaining to Spain after Cervera's mishap, was the actual condition before that event; to the extent at least of our certain knowledge of what the Spanish navy might, or might not, be able to do. Had the enemy had no army in Cuba, and had he pursued his proper course by recalling Cervera from the Cape Verde Islands to Spain, as a preliminary to sending the concentrated fleet across the ocean, we might have sent troops to seize and strengthen themselves in Cuba's strategic ports; but, in the face of the then Spanish army, it was not possible to do so to any good effect. Consequently, we did not attempt it, until Cervera was cornered.

Probably our people at large are conscious that colonial possession involves a colonial army. This the experience of Great Britain tells us may be largely, though not wholly, aboriginal; and that the less developed the civilization of the natives, the greater the proportion of the latter may be to the whole force. But it is doubtful whether the general acquiescence in the necessity of such an army is accompanied by an exact understanding of the part it plays in maintaining possession; what its strength is, and what its weakness, considered, not in itself alone, but in relation to the whole problem of national and colonial defence. The function and effect of the Spanish army in Cuba illustrate this, and therefore are important to be understood, for the appreciation, not of recent history only, but of the necessary future policy of the United States as well. The navy binds all together; without it each falls in time, isolated and unsupported. In 1762, as in 1898, in one twelve-month Spain lost both Manila and Havana, and for the same reason — defective sea power. But in order that the navy, the mobile force, may assure the whole, it is necessary that each part be able to resist attack during a measurable period, exactly as a fortress on any scene of warfare. Each colony, until it becomes self-supporting and fit for independence, is an exposed garrison. They are plausibly right, therefore, who argue that as a general rule a country does not consult its immediate interests by acquiring colonies. Their error is in failing to

recognize that immediate self-interest is not always the sole test, although it furnishes us a very adequate reason for taking Hawaii. It may be a duty to accept a responsibility which is not to one's convenience. For what other reason than duty is civic activity immediately incumbent on the well-to-do?

It is interesting to find the same conditions revealing themselves in the minutiæ of specific instances as truly as in broad generalizations. In the broad history of policy we shall find illustrated the mutual dependence of the active army and navy, of seacoast fortification and the fleet. It is a curiously ironical comment upon human foresight that the issue of the war turned upon the tenure of that one of the great Cuban ports, which at the first certainly seemed least likely to be involved, as a scene of actual conflict. From Spanish sources we learn that Cervera entered the port because it was the only one available. If such was actually the reason for this seemingly fortuitous step, he acted under a misapprehension of our dispositions. Until he had so entered, however, his squadron was the controlling factor in the general situation. The navy of the defence, though locally much inferior to its opponent, was yet too strong to justify our exposing troops upon the maritime high roads; and it rested also on several fortified ports, from any of which it might issue to attack our interests, and in which it might find refuge, when pressed for supplies or by our ships. The Spanish tenure of Santiago made the squadron therein secure; and although a singular lack of enterprise, as yet unexplained, paralyzed it as an active factor, the mere possibilities of offensive movement open to it imposed upon us its neutralization and, if feasible, its destruction. The former was insured to the utmost degree practicable when our fleet had been concentrated before the port; but from direct attack it was preserved by the territorial army, supporting the permanent fortifications and the lines of torpedoes. These cannot be overcome by ships alone, unless the assailant is able to throw away not only lives of men, who may be replaced, but ships which cannot. Those who can recall conditions at the time, not only as regards our immediate enemy, but the rumored dispositions of other states reported to be unfriendly toward us, will understand that the preservation of our navy in undiminished force was a political consideration of paramount importance. We could not afford then to lose ships, unless at the same time we diminished by at least an equal amount the naval force which might yet be arrayed against us.

Our army, therefore, was called upon to make untenable the refuge which sheltered the hostile fleet. That we were able to move our troops to the scene of action with perfect assuredness was due to the fact that our navy had established its predominance in the local waters; and conversely, Spain suffered invasion of her colony because she had lost control of the sea. Our troops, when landed, depended for their security and for their supplies upon the continuance of this maritime condition; the sea, in short, was its line of communications, which the navy protected. On the other hand, unless Cervera were forced to quit the port by famine, produced by the blockade — a not impossible contingency — the navy could not get at his ships to destroy them without the aid of the army; and destruction was necessary, for, as the French proverb says, "It is only the dead who do not return" inconveniently. The army's aid might be extended in one of two ways. Either it might — if it could — get possession of the town by its own unaided efforts, or by establishing a dominant position overlooking it; or it might direct its attempt, aided by the navy, upon the works commanding the harbor's mouth. These reduced, the navy would be able to remove the torpedoes, enter the port, and engage the hostile squadron.

These details of comment, however, do not at all affect the general propositions upon which the writer has sought to fasten the attention of his readers; the mutual dependence of army and navy, in the attack or defence of maritime regions, and the primacy therein of the navy, which represents both the communications and the offensive element of the war upon the sea. By the neglect of these considerations Spain lost her colonial empire. By the observance of them Great Britain has preserved hers, and the English-speaking race dominates the sea. In this predominance, further, are involved the issues of that mysterious future, the movings of which we are now beginning to discern, as in a glass darkly; and which the race holds within its grasp, if only through wise guidance of popular thought by those who have time to think, it can find its way, not by formal alliance but by political comprehension, to common action and to mutual support.

A. T. Mahan,
Author of 'Influence of Sea-Power,' Etc.

Ar'my Corps, a term denoting one of the largest divisions of an army in the field, comprising all arms, and commanded by a general officer; but subdivided into divisions, which may or may not comprise all arms.

Ar'my Hospital Train, a railway contrivance for military purposes, introduced by the surgeon-general of the United States army during the war with Spain, in 1898, for the purpose of conveying sick and wounded soldiers, on their arrival from Cuba, at Florida ports, to various military hospitals in the United States. This train had a full staff of physicians, surgeons, and trained nurses, and was completely equipped with everything necessary for medical and surgical treatment of soldiers. It is believed to have been the first train service completely organized for such purpose.

Ar'my Register, an annual publication of the United States government giving personal, regimental, and other details of the regular army, and corresponding to the British 'Army List.'

Ar'my Reserve, in most European armies, a force consisting of a first and second class army reserve and a militia reserve. The first class army reserve consists: (1) Of men who have completed their period of seven years in the active army, and of men who, after having served not less than three years in the active army, have been transferred to the reserve to complete the term of their engagement; (2) of soldiers who have purchased their discharge and enrolled themselves in the reserve for five years.

In time of war or when the country is threatened, the men of this class become liable for the same services as the active army. The second class army reserve is made up of enrolled pensioners, and is liable only for service at home. The militia reserve is composed of men belonging to the militia who voluntarily enroll themselves in this reserve for a period of six years, thus rendering themselves liable to be drafted into the regular army in case of war. In the United States there is no Federal army reserve, but each State maintains a militia force under the command of the governor, principally to aid the legal authorities in maintaining peace within its limits. In emergencies threatening the whole country, and where the regular army is insufficient, the President calls for volunteers, apportions the number needed among the several States, and asks the governors to supply the determined quotas. The bulk of the volunteer army is thus drawn from the miltia.

Ar'my Schools. See Army War College; Military Schools.

Army of the United States, The. The Constitution gives to Congress the power to provide for the common defense and general welfare of the United States, "to declare war," "to raise and support armies," and "to make rules for the government and regulation of the land and naval forces." The responsibility, therefore, for the common defense rests with Congress, for all the power essential to meet it is vested in the legislature of the nation, which has supreme control.

During the War of the Revolution General Washington was unanimously elected 15 June 1775, "to command all the continental forces raised or to be raised, for the defense of American liberty," but on assuming command, he found an heterogeneous and undisciplined force, and immediately took measures to bring order out of confusion; and the General having recommended to the Congress and pointed out the necessity for a war office, that body, on 13 June 1776, created a Board of War, composed of its own members, which body was the germ of the War Department of our Government. During 1781 the Continental Congress, having under consideration a plan for the arrangement of the civil executive departments, established among others the office of Secretary of War, to which Major-General Lincoln was elected, and at this juncture several acts were passed defining the duties of the office, organizing various of the Staff Corps, and providing for a military establishment.

From that period, although Congress has made appropriations for the support of the army, and passed laws for its better efficiency, the evolution of organization and equipment and of the general (administrative and supply) staff has only been accomplished through tentative measures, and to meet emergencies. It is of little interest, therefore, to review its history in this respect, for the past few years have brought about a complete revolution in the organization, equipments, tactics, and armaments of an army.

From the early history of our country the sentiment of the people as expressed through the Congress, has always been opposed to a standing army in time of peace, but the Constitution itself declares that "A well-regulated militia being necessary to the security of a free state, the right of the people to keep and bear arms shall not be infringed." It has been the continuous policy of the government to maintain only a small army, and to rely in any great war upon the volunteers, and after each, to disband the citizen soldiery and reduce the regular establishment to a peace basis.

With the exception of periods of actual warfare, the functions of the regular army are to man the seacoast fortifications, which protect our harbors and great cities from hostile attack, and to garrison the outposts on the western frontier, and at such strategic points as Congress determines to be suitable; to be always ready to fight for the country in any sudden emergency which may come upon it before there is time to raise a volunteer force, and during the time such a force is being raised; to constantly study, and experiment upon, and exercise in, all the improvements in military science, both in arms, ammunition, equipment, supplies, sanitation, transportation, drill and tactics; to furnish a nucleus of officers and men thoroughly familiar with the business for strengthening and ready instruction of the volunteer army.

Strength and Organization.— The following table shows the *authorized* strength of the regular army under the various acts of Congress from 1789 to 1901:

Acts.	Officers.	Enl. Men.
Sept. 29, 1789	46	840
April 30, 1790	57	1,216
March 3, 1791	104	2,128
March 5, 1792	258	5,156
May 30, 1796	233	3,126
April 27, 1798	289	3,870
May 27, 1798	303	10,000
July 16, 1798	783	13,638
March 3, 1799	2,447	49,244
May 14, 1800	318	4,118
March 16, 1802	241	3,046
April 12, 1808	774	9,147
June 26, 1812	1,657	34,095
March 3, 1813	3,260	54,091
March 30, 1814	3,495	59,170
March 3, 1815	674	11,709
March 2, 1821	589	5,586
April 5, June 15, 28, 1832	540	6,540
March 2, 1833	599	6,595
May 23 and July 4, 1836	647	7,310
July 5 and 7, 1838	735	11,804
May and June, 1846	775	17,020
Feb. 11 and March 3, 1847	1,353	29,512
Aug. 14, 1848	882	9,435
June 17, 1850*a*	889	11,000
March 3, 1855*b*	1,040	16,882
July 29 and Aug. 3, 1861	2,009	37,264
July 28, 1866*c*	3,036	51,605
March 3, 1869	2,277	35,036
July 15, 1870	2,264	30,000
June 16, 1874	2,151	25,000
March 8, 1898	2,137	26,610
April 26 and July 7, 1898	2,432	63,106
March 2, 1899	2,585	65,000
Feb. 2, 1901*d*	3,860	60,450

a By the Act of 17 June 1850 the President is authorized to increase the number of privates in each of the companies of the army, serving, or which may hereafter serve, at the military posts of the western frontier, and at remote and distant stations, to any number not exceeding 74, which if all had been serving at distant stations would have made the total maximum enlisted strength 13,885, the minimum being 9,385 enlisted men.

b The minimum authorized enlisted strength under the Act of 3 March 1855, was 11,658, and the maximum 17,278.

c The Act of 28 July 1866 fixed the minimum enlisted strength at 51,605, and the maximum at 77,250.

d The Act of 2 February 1901 fixes the minimum strength at 59,131 enlisted men and the maximum at 100,000, the number of officers remaining the same.

The regular army on 1 Jan. 1898, just prior to the declaration of war with Spain, consisted of 2,157 officers and 25,350 men, all told. War being imminent, the Congress during March and April, 1898, passed certain acts for the better organization of the line of the army, which authorized a maximum enlisted strength of 65,000 men; increased the artillery by two regiments; added to each infantry regiment a third battalion of four companies each; provided for additional non-commissioned officers for the regiments, squadrons, and battalions, and for the troops and companies; and the enlisted strength of each unit was considerably augmented.

By an act approved 22 April 1898, the Congress made provision for accepting into the service the militia (National Guard organizations) and volunteers from the various States, and made the following declaration with respect to the National forces:

> All able-bodied male citizens of the United States, and persons of foreign birth who shall have declared their intention to become citizens of the United States . . . between the ages of 18 and 45, are hereby declared to constitute the National forces, and with such exceptions and under such conditions as may be prescribed by law, shall be liable to perform military duty in the service of the United States.
>
> That the organized and active land forces of the United States shall consist of the army of the United States and of the militia of the several States when called into the service of the United States: Provided, that in time of war the army shall consist of two branches which shall be designated, respectively, as the regular army and the volunteer army of the United States.
>
> That the regular army is the permanent military establishment, which is maintained both in peace and war according to law. That the volunteer army shall be maintained only during the existence of war, or while war is imminent, and shall be raised and organized (as prescribed by the statute) only after Congress has, or shall have authorized the President to raise such a force or to call into the actual service of the United States the militia of the several States.

The law authorized enlistments to be made for the term of two years, unless sooner terminated, and that all officers and men composing the volunteer army should be discharged when the purposes for which they were called into service were accomplished, or on the conclusion of hostilities.

The law further prescribed that the President should issue his proclamation, when it became necessary to raise the volunteer army, stating the number of men desired (within the limits prescribed); enjoined the Secretary of War with the duty of examining, organizing (as prescribed for in the regular army), and receiving into the service the men called for, and as far as practicable these troops were to be accepted only in proportion to the population of the several States and Territories. The law also required that the organizations of the volunteer army should be maintained as near their maximum strength as was deemed necessary by the President, and prohibited the acceptance of new organizations unless those already in service from the States were kept fully recruited.

The law also authorized (in addition to those already provided for by law) the appointment of general, and general staff officers of volunteers, sufficient for the proper command of the combined forces, and permitted of regular officers holding volunteer commissions without prejudice to their regular army status.

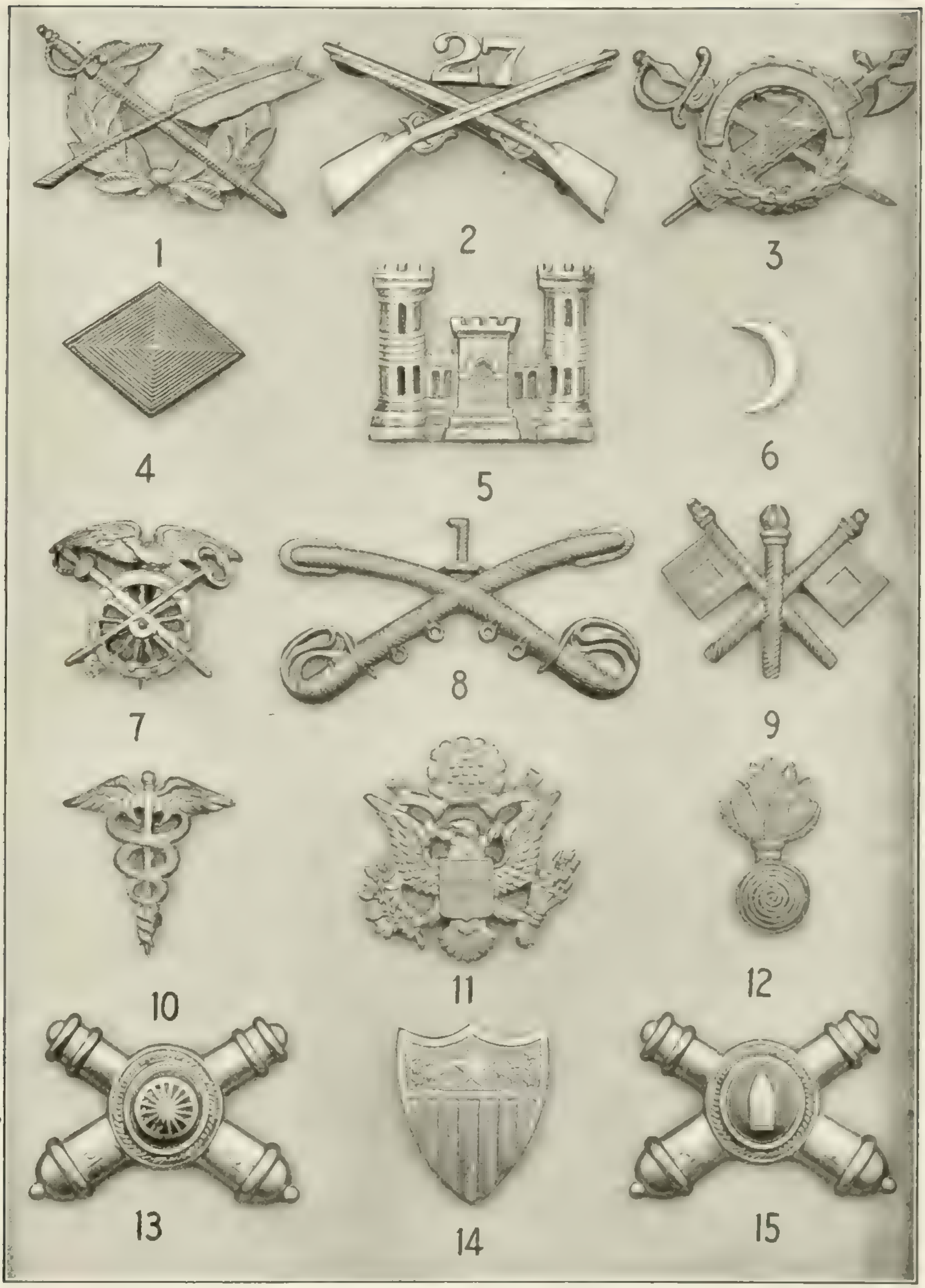
Of this army, three regiments of engineer troops, three of cavalry, and ten of infantry were United States volunteers recruited from the nation at large — all of the officers being commissioned by the President. As fast as the State troops were presented properly organized, they were mustered into the service of the United States. The total number furnished for the war with Spain was 10,017 officers (387 officers of the regular army received volunteer commissions) and 213,218 enlisted men.

The close of the war brought into operation the provisions of the acts of 22 April and 26 April 1898, which required that at the end of the war the entire volunteer forces should be discharged and the regular army reduced to a peace basis, thus making necessary the discharge of about 35,000 regular troops, 110,000 volunteers, and substantially all of the 5,000 volunteer line and staff officers.

The act of 2 March 1899, was passed in view of the insurrection in the Philippine Islands, and gave authority to again increase the regular army to a strength not exceeding 65,000 men, and to raise a force of not more than 35,000 volunteers to be recruited from the country at large — the field officers being appointed from among the officers of the regular army, 233 officers holding such commissions. All the volunteers authorized by this act were recruited and forwarded to the Philippine Islands by January 1900, and there actively employed in military operations. During that year about 42,000 men of the regular army and 31,000 of the volunteers were in service in the Philippine archipelago. This act contained the provision that all general staff and line officers appointed, and the volunteer troops raised, under its provisions, should be discharged not later than 1 July 1901 and the regular army reduced to the number as provided by law prior to 1 April 1898, exclusive of the addition made to the artillery; but the Congress, recognizing the necessity for a larger and more perfectly organized army, passed a law, which was approved 2 Feb. 1901, providing for an increase of line organizations from 25 regiments of infantry to 30, and 10 regiments of cavalry to 15, and from 7 regiments of artillery, including 14 field and 2 siege batteries, to the equivalent of 13 regiments (organized into 30 batteries of field artillery and 130 companies of coast artillery), and 5 companies of engineers to 12 companies, representing 3 battalions. The minimum and maximum numbers of enlisted men for the different arms were established by the same statute, so that the total number of enlisted men might be varied by the President according to exigencies from a minimum of 59,131 to a maximum of 100,000 (including a corps of Philippine Scouts, which is limited to 12,000), the commissioned personnel remaining the same.

The regular army is recruited (through the agency of recruiting officers maintained in the principal cities and towns) in times of peace and war by voluntary enlistments (term of service three years) from among citizens of the United States, between the ages of 18 and 35, of good character and temperate habits, able-bodied, free from disease, and with educational capacity to speak, read, and write the English language. The native born constitute about 90 per cent of the enlistments in the army.

INSIGNIA UNITED STATES ARMY.



Arranged by Harold L. Crane, N. Y. City.

1. Judge-Advocate General's Department.
2. Infantry.
3. Inspector General's Staff.
4. Pay Department.
5. Engineer Corps.
6. Subsistence Department.
7. Quartermaster's Department.
8. Cavalry.
9. Signal Corps.
10. Medical Department.
11. Coat of Arms.
12. Ordnance Department.
13. Field Artillery.
14. Adjutant General's Department.
15. Coast Artillery.

In addition to the pay ($13.00 per month for the private being the minimum), all soldiers receive from the government, rations, clothing, shelter, medicine and medical attendance, and certain increases in the fixed pay for continuous service. Soldiers can deposit their savings with the paymasters, and are allowed four per centum per annum thereon on final discharge. For those who have served honestly and faithfully 20 years, or who have been discharged for wounds received or disease incurred in service, a comfortable home is maintained in the city of Washington, toward the maintenance of which each soldier contributes 12½ cents per month from his pay, and all court-martial fines and forfeitures and pay due deserters go to the home.

In addition to the combatant force proper, the law authorizes the enlistment of musicians; for the cavalry troops, cooks, blacksmiths and farriers, saddlers and wagoners; for the artillery corps, electricians, cooks, mechanics and artificers; and cooks and artificers for the infantry. Special technical skill is required for enlistment in the engineer, signal and hospital corps.

Officers: Appointment to, Advancement in, and Retirement from the Military Service.— The power to make appointments is vested in the President and the Senate of the United States, acting concurrently, within the limits of the enactments of Congress, which do not encroach upon the prerogatives of the executive, who, under the Constitution is the Commander-in-Chief of the army and navy of the United States.

The army is officered, (1) from the graduates of the Military Academy, to which young men may be admitted between the ages of 17 and 22. Candidates must be free from any infectious or immoral disorder, and any deficiency which may render them unfit for the military service, and must be possessed of a good elementary education; the examination for entrance being made to conform to the courses of study ordinarily covered in the high schools and academies of the country by boys of average age of appointees, and they may be admitted upon certificates from educational institutions. Two cadets-at-large are allowed each State (designated by the respective Senators), and one for each congressional district, Territory, and the District of Columbia. In addition to this number the President is allowed a number of appointments, which are usually made from among the sons of officers of the army and navy.

The commanding officer of the academy, who has the title of Superintendent, is detailed from the army and has the temporary rank of colonel. For the purpose of discipline and tactical instruction, the cadets are organized as a battalion of four companies, with officers and non-commissioned officers selected from among their own numbers. The corps is commanded by an officer having the temporary rank of lieutenant-colonel. He is also an instructor in drill regulations of the three arms of the service. An officer of engineers and of ordnance are detailed as instructors of practical military engineering and of ordnance and gunnery, respectively. The heads of the other departments of instruction have the title of professors. They are selected generally from officers of the army, and their positions are permanent. The officers before mentioned and the professors constitute the academic board. The military staff and assistant instructors are officers of the army. The course of instruction covers four years, and is very thorough. Theoretical instruction comprises mathematics, French, Spanish, English, drawing, physics, astronomy, chemistry, ordnance and gunnery, art of war, civil and military engineering, international, constitutional, and military law, history, and drill regulations of all arms. The practical instruction comprises service drills in infantry, cavalry, and artillery, surveying, reconnaissances, field engineering, and gymnastics. The discipline at the academy is very strict — more so than in the army. In addition to a training and education fitting the cadets for the military service, the aim is to inculcate habits of prompt and cheerful obedience to lawful authority, of neatness, order, and regularity, and of thoughtfulness and attention to the discharge of duty. A scrupulous regard for truthfulness is also required. Upon graduation commissions for the rank of second lieutenant are usually conferred by the President, and the graduates are given a choice as to the arm of service and regiments, as far as practicable, those graduating at the head of the class having preference. The military academy, on 11 June 1902, celebrated with appropriate ceremonies the completion of one hundred years of honorable and useful service; and liberal appropriations by Congress for rebuilding and extending the institution will enable it to begin its second century with the well-founded hope of larger and long-continued usefulness.

In the event of remaining vacancies in the grade of second lieutenant in any year further appointments are made, (2) from among the enlisted men of the army who are authorized by law to enter a competitive examination, after two years' service, provided they be between the ages of 21 and 30, unmarried, and physically and morally qualified. To obtain a commission the candidate must pass an educational and physical examination before a board of officers. The board also takes into consideration the character, capacity, and military record of the candidate. Many well-educated young men, unable to obtain appointments to West Point, enlist in the army for the express purpose of becoming officers through this medium. And (3) civilians are appointed to vacancies that may be left when the two first classes have been exhausted. To be eligible for appointment the candidate must be a citizen of the United States, unmarried, between the ages of 21 and 27 years, and must be approved by an examining board as to habits, moral character, physical ability, education, and general fitness for the service.

Although the military academy has in the past supplied a majority of the officers entering the service in each year, the partial increase of the army in 1898 by reason of the breaking out of hostilities with Spain, and resulting casualties, and its re-organization with increased numbers on the disbandment of the volunteer army called into service during the Spanish-American war, has necessitated the appointment of a large number of officers from among the enlisted men, volunteers, and civilians. Of the ap-

pointments to the line of the army in the four years following the Spanish-American War, about one-sixth were supplied by the military academy; the others having been appointed from the ranks, civil life, and from the volunteers of the war with Spain and in the Philippines. The volunteers and enlisted men had acquired useful experience and were selected on the ground of their military conduct and intelligence, yet this considerable influx in the commissioned personnel had not permitted of a systematic military education. To overcome this deficiency, and with a view to maintaining a high standard of instruction and general training of the officers of the army, and to keep pace with the difficulties of the problems involved in transporting, supplying, and handling armies of modern times, and for caring for and rendering effective the increasing complexity of the machines and material used in the defense of the coast fortifications, a system of military instruction is required, and accomplished through officers' schools at each military post, for elementary instruction in theory and practice, and at special service schools — (a) The Artillery School at Fort Monroe, Va.; (b) The Engineer School of Application, Washington Barracks, D. C.; (c) The School of Submarine Defense, Fort Totten, N. Y.; (d) The School of Application for Cavalry and Field Artillery at Fort Riley, Kansas; (e) The Army Medical School. A General Service and Staff College is also maintained at Forth Leavenworth; and a War College, at the city of Washington, for the most advanced instruction in the military art and science. The Congress has made provision for the maintenance of these schools, and given its sanction to the general system of military education prescribed therein.

Promotions in the line are made through the whole army by seniority, in the several arms, namely, artillery, cavalry, and infantry, respectively, between first lieutenant and brigadier-generals, relative rank being determined by length of service as an officer of the United States either in the regular or volunteer forces. Promotions among officers of the staff holding permanent commissions are made in like manner in the several departments and corps, respectively.

Educational and physical examinations are required of officers of the line upon promotion between the grades of first lieutenant and majors.

In every service, to maintain a reasonably low age among the persons actively employed, it is essential that some scale be fixed for the retirement of old and worn-out officers, and those incapacitated for active military service. When an officer in the line of promotion is retired from active service, or in the event of casualties, by reason of retirements, resignations, or deaths, the next officer in rank is promoted to his place, and the same rule of promotion is applied successively, to the vacancies consequent upon such casualties.

The laws for the retirement from the military service provide:

(1) If an officer has had 30 years' service (and makes application therefor), or if he has reached the age of 62, he *may* be placed on the retired list.

(2) If an officer has been borne on the army register for 40 years (and makes application therefor), or if he has reached the age of 64, he *shall* be retired from active service.

(3) An officer may also be retired on account of disability contracted in the line of duty; or, *wholly* retired, if his incapacity is not the result of an incident of service, and his name dropped from the rolls of the army.

(4) In like manner enlisted men of the army may be retired after 40 years of service.

Officers and enlisted men on the retired list receive 75 per cent of the pay of the rank held upon retirement, but they are withdrawn from command and promotion, except, that officers may be assigned to duty as military instructors at colleges, and at the Soldiers' Home (D. C.). They are, however, amenable to the rules and articles of war, and subject to trial by court-martial for a violation thereof.

The Staff of the Army.— The Secretary of War is the head of the War Department, and performs such duties as are required of him by law, or may be enjoined upon him by the President concerning the military establishment and administers its affairs and promulgates the orders and directions of the President through a chief of staff, who has, under the Secretary of War, supervision of all troops of the line and of the administration of the several staff departments. The Secretary of War is charged with the supervision of estimates of appropriations, of all purchases of army supplies, of all expenditures for the support, transportation, and maintenance of the army; and such expenditures of a civil nature as may be placed by Congress under his direction. He also has supervision of the Military Academy and of military education in the army, of the Board of Ordnance and Fortification, of the various battlefield commissions. He has charge of all matters relating to national defense and seacoast fortifications, army ordnance, river and harbor improvements, etc. He also has charge of the establishment or abandonment of military posts, and of all matters relating to lands under the control of the War Department. His duties also embrace all matters pertaining to civil government in the island possessions subject to the jurisdiction of the War Department.

But twice in the history of military legislation has provision been formally made for the office of Chief of Staff of the Army: (1) in the act of 3 March 1813, which has never been repealed in express terms, and (2) in the act of 3 March 1865, repealed by the act of 3 April 1869.

While legislative sanction is not required to enable the President to assign an officer to duty as Chief of Staff, a position demanded by the necessities of the service, Congress, by the act of 14 Feb. 1903, formally authorized the office and declared that under the direction of the President or the Secretary of War, that the Chief of Staff shall have supervision of all troops of the line and of the Adjutant-General's, Inspector-General's, Judge Advocate's, Quartermaster's, Subsistence, Medical, Pay and Ordnance Department, the Corps of Engineers, and the Signal Corps.

It is required of the general staff under the law, to prepare plans for the national defense

and for the mobilization of the military forces in time of war; to investigate and report upon all questions affecting the efficiency of the army and its state of preparation for military operations; to render professional aid and assistance to the Secretary of War and to general officers and other superior commanders, and to act as their agents in informing and co-ordinating the action of all the different officers who are subject to the supervision of the Chief of Staff and to perform such other military duties, not otherwise assigned by law, as may be, from time to time, prescribed by the President or the Secretary of War.

With respect to the staff the tendency has been to fill its offices from the line, and this prevails at this day, except in the Medical Department (which is open to appointment from civil life, after examination as to professional capacity) and the chaplains; but since 1851, when the regular law of promotion was secured to each of them, it has been necessary that a newcomer should enter at the foot of the list, except indeed he entered at its head, as Generals Johnston and Meigs did in the Quartermaster's Department; but that was in the days when all general officers were selected from the army at large. At present the law confines the selection to the chiefs of departments.

Having in view especially the duties to be performed by regular officers in connection with the volunteer force, a system of detail from the line of the army has been provided for (which in a measure abolishes the permanent staff), in order to give a training for as many officers as possible in a variety of experience which will fit them for the duties of the staff and regular command in the combined force of regulars and volunteers.

In time of peace the military administration of the army is conducted by the Secretary of War through the Chief of Staff and the several bureaus; and the country is divided into military geographical departments, which is similar to the command of a separate army, with the same powers and duties in similar cases over all the troops within the limits of the department. The commander is assigned to duty by the President, who alone can relieve him, and who also fixes the limits or boundaries of the command.

In time of war, military forces are organized into armies, corps, divisions and brigades; and for each (as well as the commander of a military department) is provided a competent administrative staff, which is allied in its personnel and duties to the staff for the whole army, which is outlined below:

ORGANIZATION OF THE STAFF OF THE U. S. ARMY.

	Major-Generals.	Brigadier-Generals.	Colonels.	Lieutenant-Colonels.	Majors.	Captains.	First Lieutenants.	Second Lieutenants.	Ordnance Sergeants.	Post Commiss'y Sergts.	Post Q. M. Sergeants.	Hospital Stewards.	Signal Sergts. 1st Class.	Sergeants.	Act'g Hosp. Stewards.	Corporals.	Cooks.	Privates, 1st Class.	Privates.	Total Commissioned.	Total Enlisted.	Aggregate.
General Officers	6	15																		21		21
*Adjt. Gen'l Dept	1		5	7	15															28		28
*Insp. Genl's Dept		1	4	4	8															17		17
J. A. Genl's Dept		1	2	3	6															12		12
*Q. M. Dept		1	6	9	20	60					*c*150									96	150	246
*Subsist. Dept		1	3	4	9	27				*b*200										44	200	244
Medical Dept		1	8	12	60	43	*a*197					300			400				3,300	321	*d*4,000	*d*4,321
*Pay Dept		1	3	4	20	25														53		53
*Ordnance Dept		1	4	6	13	24	24		110					60		78		261	191	72	700	772
Corps of Engineers		1	7	14	28	40	40	30											1,282	100	*e*1,282	*e*1,442
*Signal Corps		1	1	1	4	14	14						130	120		150	10	250	150	35	810	845
Rec'd & Pen. Office		1			1															2		2
Total	7	25	43	64	184	233	275	30	110	200	150	300	130	180	400	228	10	511	3,641	862	7,142	8,003

* Sec. 26 of the act of 2 Feb. 1901, provides, "that so long as there remain any officers holding permanent appointments in the Adjutant-General's Department, the Inspector-General's Department, the Quartermaster's Department, the Subsistence Department, the Pay Department, the Ordnance Department, and the Signal Corps, including those appointed to original vacancies in the grades of captain and first lieutenant under the provisions of sections sixteen, seventeen, twenty-one, and twenty-four of this act, they shall be promoted according to seniority in the several grades, as now provided by law, and nothing herein contained shall be deemed to apply to vacancies which can be filled by such promotions or to the periods for which the officers so promoted shall hold their appointments; and when any vacancy, except that of the chief of the department or corps, shall occur, which can not be filled by promotion as provided in this section, it shall be filled by detail from the line of the Army, and no more permanent appointments shall be made in those departments or corps after the original vacancies created by this act shall have been filled. Such details shall be made from the grade in which the vacancies exist, under such system of examination as the President may from time to time prescribe.

"All officers so detailed shall serve for a period of four years, at the expiration of which time they shall return to duty with the line, and officers below the rank of lieutenant-colonel shall not again be eligible for selection in any staff department until they shall have served two years with the line.

"That when vacancies shall occur in the position of chief of any staff corps or department the President may appoint to such vacancies, by and with the advice and consent of the Senate, officers of the Army at large not below the rank of lieutenant-colonel, and who shall hold office for terms of four years. When a vacancy in the position of chief of any staff corps or department is filled by the appointment of an officer below the rank now provided by law for said office, said chief shall, while so serving, have the same rank, pay, and allowances now provided for the chief of such corps or department. And any officer now holding office in any corps or department who shall hereafter serve as chief of a staff corps or department and shall subsequently be

The Adjutant-General promulgates all orders of a military character of the President, and the Secretary of War, and conducts the general correspondence of the army; receives reports and returns; prepares commissions, appointments, and acceptances of resignations for issuance; and has charge of the recruiting service.

The Inspector-General, with his assistants, inspects all military commands and stations, the schools of application, the military departments of all colleges and schools at which officers of the army are detailed, all depots, rendezvous, armories, arsenals, fortifications, and public works of every kind under charge of or carried on by officers of the army; and also the money accounts of all disbursing officers of the army.

The Quartermaster-General, aided by assistants, provides transportation for the army; also clothing and equipage, horses, mules, and wagons, vessels, forage, stationery, and other miscellaneous quartermaster stores and property for the army, and clothing and equipage for the militia; constructs necessary buildings, wharves, roads, and bridges at military posts, and repairs the same; furnishes water, heating and lighting apparatus; pays guides, spies, scouts, and interpreters, and is in charge of national cemeteries.

The Commissary-General of Subsistence has administrative control of the Subsistence Department; the disbursement of its appropriations; the providing of rations and their issue to the army; the purchase and distribution of articles authorized to be kept for sale to officers and enlisted men; the administrative examination of accounts of subsistence funds preliminary to their settlement by the proper accounting officers of the Treasury; and the examination and settlement of returns of subsistence supplies.

The Surgeon-General is charged with the administrative duties of the Medical Department; the designation of the stations of medical officers, and the issuing of all orders and instructions relating to their professional duties. He directs as to the location, purchase, and distribution of the medical supplies to the army. The Army Medical Museum and the official publications of the Surgeon-General's office are also under his direct control.

The Paymaster-General is charged with the payment of the officers and enlisted men of the army and civil employees of the Department; with furnishing funds to his officers and seeing that they duly account for the same, and with a preliminary examination of their accounts; also with the payment of Treasury certificates for bounty, back pay, etc., and balances due deceased officers and soldiers of the Volunteer and Regular army.

The Chief of Engineers is charged with all duties relating to construction and repair of fortifications, whether permanent or temporary; with all works of defense; with all military roads and bridges, and with such surveys as may be required for these objects, or the movement of armies in the field. It is also charged with the river and harbor improvements, with military and geographical explorations and surveys, with the survey of the lakes, and with any other engineer work specially assigned to the corps by acts of Congress or orders of the Secretary of War.

The duties of the Chief of Ordnance consist in providing, preserving, distributing, and accounting for every description of artillery, small arms, and all the munitions of war which may be required for the fortresses of the country, the armies in the field, and for the whole body of the militia of the Union. In these duties are comprised that of determining the general principles of construction and of prescribing in detail the models and forms of all military weapons employed in war. They comprise also the duty of prescribing the regulations for the proofs and inspection of all these weapons, for maintaining uniformity and economy in their fabrication, for insuring their good quality, and for their preservation and distribution.

The Judge-Advocate-General is directed by law to "receive, review, and cause to be recorded the proceedings of all courts-martial, courts of inquiry, and military commissions." He also furnishes the Secretary of War information and advice relating to lands under control of the War Department, and reports and opinions upon legal questions arising under the laws, regulations, and customs pertaining to the army, and upon questions arising under the civil laws; reports upon applications for clemency in the cases of military prisoners; examines and prepares legal papers relating to the erection of bridges over navigable waters; drafts bonds, and examines those given to the United States by disbursing officers, colleges, and others; examines, revises, and drafts charges and specifications against officers and soldiers; and also drafts and examines deeds, contracts, licenses, leases, and legal papers generally.

The Chief Signal Officer is charged with the supervision of all military signal duties, and devices connected therewith, including telegraph and telephone apparatus and the neces-

---

retired, shall be retired with the rank, pay, and allowances authorized by law for the retirement of such corps or department chief: *Provided*, That so long as there remain in service officers of any staff corps or department holding permanent appointments, the chief of such staff corps or department shall be selected from the officers so remaining therein."

a. Assistant surgeons have the rank, pay, and emoluments of First Lieutenants of Cavalry for the first five years' service, and the rank, pay, and emoluments of the grade of captain after five years' service. (Sec. 4, Act 23 June 1874.)

b. By the Act of 3 March 1873, the Secretary of War is authorized to select from the sergeants of the line of the Army, who shall have faithfully served therein five years, three years of which in the grade of non-commissioned officer, as many Commissary Sergeants as the service may require, not to exceed one for each military post or place of deposit of subsistence supplies.

c. By the Act of 5 July 1884, the Secretary of War is authorized to appoint as many Post Quartermaster Sergeants as he may deem necessary for the interests of the service, not to exceed eighty, to be selected by examination from the most competent enlisted men of the Army who shall have served at least four years. The act of 8 July 1898, increased the number of Post Quartermaster Sergeants to one hundred and five; and the Act of 2 Feb. 1901, further increased the number to one hundred and fifty.

d. The Act of 1 March 1887, organizing the Hospital Corps provides that it shall consist of Hospital Stewards, Acting Hospital Stewards, and Privates, and that it shall be permanently attached to the Medical Department, and shall not be included in the effective strength of the Army nor counted as a part of the enlisted force provided by law.

e. The Act of 2 Feb. 1901, provides for three battalions of engineer troops, and although commanded by listed force is included in the strength of the line of the Army.

sary meteorological instruments for use on target ranges and other military uses; the construction, repair, and operation of military telegraph lines, and the duty of transmitting information for the army by telegraph or otherwise, and all other duties usually pertaining to military signaling.

The Chief of the Record and Pension Office is charged by law with the custody of the military and hospital records of the volunteer armies and the transaction of the pension and other business of the War Department connected therewith, including the publication of the Official Records of the War of the Rebellion.

Organization of the Line of the Army.— Each regiment of cavalry consists of 12 troops and one band, organized into 3 squadrons of 4 troops each, and under the minimum requirements of the law is constituted as follows:

For each regiment: 1 colonel and 1 lieutenant-colonel, 1 chaplain, and 2 veterinarians. The non-commissioned staff consists of a regimental sergeant-major, 1 quartermaster-sergeant, 1 commissary-sergeant, and 2 color sergeants. Three additional captains and 3 first and second lieutenants, being authorized beyond the requirements of the troops, are available for detail as regimental and squadron adjutants, quartermasters and commissaries. For each troop: 1 captain, 1 first and 1 second lieutenant, the enlisted force consisting of 1 first sergeant, 1 quartermaster-sergeant, 6 sergeants, 6 corporals, 2 cooks, 2 blacksmiths and farrier, 1 saddler, 1 wagoner, 2 trumpeters, and 43 privates. A major commands each squadron, for which a staff consisting of an adjutant (1st lieutenant) and quartermaster and commissary (2d lieutenants) and 1 sergeant-major is authorized.

The regimental organization of the artillery arm has been discontinued, and it is constituted and designated as the Artillery Corps, comprising two branches, namely: The Coast Artillery, defined by law as that portion charged with care and use of the fixed and movable elements of land and coast fortifications, including submarine mine and torpedo defenses; and the Field Artillery, as that portion accompanying an army in the field, and including field and light artillery proper, horse artillery, siege artillery, mountain artillery, and also machine-gun batteries.

The Artillery Corps consists of a chief of artillery selected and detailed by the President from among the colonels of artillery to serve as a member of the General's staff, his duties being prescribed by the Secretary of War; 14 colonels (one of whom shall be chief of artillery, with the rank of brigadier-general), 13 lieutenant-colonels, 39 majors, 195 captains, 12 chaplains, 195 first lieutenants, 195 second lieutenants (surplus captains and lieutenants not required for duty with batteries or companies being available for duty as staff officers of the various artillery garrisons, and other details); 21 sergeants-major senior grade, and 27 sergeants-major junior grade; 1 electrician-sergeant is authorized for each coast artillery post having electrical appliances; 30 batteries of field artillery, 126 batteries of coast artillery, and 10 bands constitute the strength of an artillery force not to exceed 18,920 men, the enlisted strength of the companies being fixed by the President according to the requirements of the service.

The enlisted strength authorized (24 Oct. 1902) for each field battery is as follows:

One first sergeant, 1 quartermaster-sergeant, 1 stable-sergeant, 6 sergeants, 12 corporals, 2 cooks, 4 artificers, 2 musicians, 91 privates; and for each company of coast artillery: 1 first sergeant, 1 quartermaster-sergeant, 8 sergeants, 12 corporals, 2 cooks, 2 mechanics, 2 musicians, and 81 privates.

The United States, as far back as 1886, recognizing the necessity for providing modern seacoast defenses to protect the cities and harbors, adopted a policy of liberal appropriations for seacoast defense, and to carry out a general plan for the continuing appropriations made available, passed a law creating a board of ordnance and fortification whose duty it is «to make all needful and proper purchases, experiments, and tests to ascertain, with a view to their utilization by the government, the most effective guns, small arms, cartridges, projectiles, fuses, explosives, torpedoes, armor plate, and other implements and engines of war.» The membership of this board comprises the lieutenant-general commanding the army (who is its president), one officer each from the corps of engineers and the ordnance department, two from the artillery, and one civilian.

Each regiment of infantry consists of 12 companies and 1 band, organized into 3 battalions of 4 companies each, and under the minimum requirements of the law is constituted as follows: For each regiment 1 colonel and 1 lieutenant-colonel and 1 chaplain. The non-commissioned force consists of a regimental sergeant-major, 1 quartermaster-sergeant, 1 commissary-sergeant, and 2 color-sergeants. Three additional captains and 3 additional first and second lieutenants, being authorized beyond the requirements of the companies, are available for detail as regimental and squadron adjutants, quartermasters, and commissaries. For each company, 1 captain, 1 first and 1 second lieutenant, the enlisted force consisting of 1 first sergeant, 1 quartermaster-sergeant, 4 sergeants, 6 corporals, 2 cooks, 2 musicians, 1 artificer, and 48 privates.

The President is also authorized to enlist «when in his opinion the conditions in the Philippine Islands justify such action» not to exceed 12,000 natives of those islands for service as scouts, with such officers as shall be deemed necessary, and organize them into troops, companies, squadrons, and battalions, but this force shall be included in the maximum enlisted strength of 100,000 for the whole army. Accordingly, there have been enlisted and there are now in service (15 Oct. 1902), about 5,000 Philippine Scouts. A provisional regiment of native Porto Ricans is also maintained. The field officers are selected from officers of the next lower grade in the regular army, the company and regimental and staff officers being selected by the President. The strength of the regiment on 15 Oct. 1902 was 29 officers and 840 enlisted men.

Militia.— The militia becomes national only when called into the actual service of the Federal government. The Constitution makes it the duty of Congress «to provide for organizing, arming, and disciplining the militia,» and «for

calling forth the militia to execute the laws of the Union, suppress insurrections, and repel invasions." Though the necessity for a well-regulated militia to the security of a free state is recognized by the Constitution, the arguments and the logic of facts have alike failed to secure that attention demanded by the gravity of the subject prior to the act of 21 Jan. 1903, which brings the militia laws to conform to modern requirements for efficiency and effectiveness, although repeated efforts have been made to accomplish this result from the day of Washington.

The military reserve of the United States is more than 10,000,000 men, but the volunteer organizations maintained in the States have not in the past (1902) exceeded 100,000 men.

The President is Commander-in-Chief of the militia of the several States when called into the actual service of the United States; and is empowered to call out these forces in event of invasion, actual or imminent, and in cases of insurrection or rebellion against the authority of the United States or any one of the States thereof, for a term of service not exceeding nine months. While so employed the troops receive the pay, rations, etc., of regular soldiers, are subject to the Rules and Articles of War, and their officers take precedence in rank next after officers of like grade in the regular service, or in such volunteer organizations as may also be in the service of the United States. The appointment of the officers (to the grade of brigadier-general) and the authority for training the militia according to the discipline prescribed by Congress are expressly reserved to the respective States.

The relations of the National Guard, however, to the Federal government have never been defined or settled. The confusion, controversy, and bad feeling arising from this uncertain status have been made painfully apparent during the Civil War, and at the beginning of the war with Spain.

The militia is capable of being utilized, first, as active militia when called out by the President for the specific purposes enumerated in the Constitution; second, as an already organized volunteer force when its organizations respond as such to calls for volunteers for general military purposes under authority of Congress; and, third, as the great school of the volunteer soldier, the benefits of which are received by the country when the members of the guard respond individually to calls for volunteers.

Under the militia law the regularly enlisted, organized, and uniformed active militia (popularly known as the National Guard) in the several States and Territories and the District of Columbia, constitute the organized militia of the United States; and provides that the organization and discipline thereof shall conform with that provided for the regular and volunteer armies; and contemplates establishing closer relations and better co-operation between the National Guard and the regular army, and to promote the general efficiency and dignity of the Guard as a part of the military system of the United States.

To aid in accomplishing these objects, the law provides that the general government shall furnish to the Guard the same arms which it furnishes to the regular army, and for the voluntary participation by the Guard with the regular army in maneuvers and field exercises for brief periods in each year. The law also contains provisions making the National Guard organizations which choose voluntarily to go beyond the limitations of militia service in effect a first volunteer reserve. It also provides for ascertaining by practical tests, in advance of a call for volunteers, the fitness to hold volunteer commissions, of members of the National Guard, graduates of the military schools and colleges, and other citizens with military training, thus constituting an eligible list from which in case of a call for volunteers officers may be taken.

The military forces of the United States are, therefore, as follows:

1. A regular army, capable of enlargement by the President when he sees war coming, to 100,000 men.

2. Such of the organized militia, trained as National Guard, as the President shall see fit to call into the service of the United States.

3. Such other volunteers as Congress may deem necessary to call forth from the States according to the respective quotas. See GENERAL STAFF OF THE ARMY.

H. C. CORBIN,
Major-General and Adjutant-General, U. S. A.

Army and Navy Maneuvers. The object of maneuvers is to train, in time of peace, the fighting forces of a nation by handling them, as far as practicable, as in time of war, the forces designated being divided, for this purpose, into two opposing bodies. Previous military training, or drill, is presupposed. Maneuvers are of three kinds: First, Land maneuvers, taking place entirely on land; second, Naval maneuvers, where fleets maneuver against fleets; third, Combined army and navy maneuvers. The last two are of comparatively recent origin.

European Maneuvers.— In the days of the old French monarchy, previous to the Revolution, the necessity for practice in handling large bodies of troops became apparent, and under Louis XIV. and Louis XV. large camps of instruction were instituted in France, then the leading military nation of the world. In these camps troops of all arms were concentrated for practice in field and siege warfare. Maneuvers are now annually held in all the principal countries of Europe. Prussia was the first country to follow the lead of France, and as in no other country than in Germany have they reached a higher development the German maneuvers will be taken as a type. They are the culmination and test of the military instruction of the year. As in almost all countries where military service is compulsory, the annual contingent of conscripts drawn for service is called to the colors in the autumn. Beginning with individual instruction, a progressive system of military training is carried on until the following summer, by which time the troops have been thoroughly drilled and are ready for the maneuvers. As operations in the grand maneuvers are carried on over a large extent of territory, the time fixed is after the crops are harvested so that agricultural interests are interfered with as little as possible. The annual maneuvers begin with regimental and brigade exercises for the infantry, with battalion exercises for field artillery (a battalion consists of two or more batteries) and with special maneuvers for cavalry. Maneuvers are also carried on

all over the country by the army corps not participating in the grand maneuvers. The programme for the grand maneuvers is carefully worked out beforehand by the Great General Staff at Berlin. When the maneuvers of one year are over, work is begun on the scheme of those for the next year. Staff officers are sent out to select the ground, which is changed from year to year so that the terrain may be varied and the interests of the inhabitants may be considered. Districts where there are vineyards or growing autumn crops are generally avoided. The troops to take part are selected and depots of supplies at convenient points in the theatre of operations are provided for. Foreign officers of distinction, and especially the foreign military attachés, are invited to attend. They are during the maneuvers the guests of the emperor. Officers are specially detailed to accompany them. They are furnished with plans of operations, with maps, and with all other necessary information. In the grand maneuvers a large body of troops of all arms always takes part; often as many as four army corps, seldom less than two. In 1901, for instance, the forces comprised two army corps, with some additional regiments of infantry from other corps, two divisions of cavalry, and 538 guns, including horse artillery, light artillery, field howitzers and machine guns; altogether about 75,000 men and 18,000 horses. (In the grand maneuvers in France in 1901, which were witnessed by the Czar of Russia, about 140,000 troops took part.)

The supreme control of the grand maneuvers is exercised by a director of maneuvers, who is frequently the emperor himself. Several officers of high rank are designated as umpires. Their duty is to watch all the operations carefully, observe mistakes and estimate results. They decide, for instance, whether a certain attack was properly made, and whether or not it was successful. They direct to be temporarily withdrawn from action a unit supposed to be disabled or captured. In actual war this would not be necessary, but in simulated war, where blank cartridges are used, no one on either side is hurt and the opposing lines come within close distance of each other without loss of numbers and with their nerves unshaken. It is therefore necessary to have expert disinterested judges to decide what the losses would have been, to what extent the morale of the troops might have been impaired, and what the results of the conflict would have been had it been a real and not an imaginary battle.

The time for concentration having arrived, the troops designated proceed to their rendezvous by marching or by rail. In 1901 the first corps marched nearly 200 miles at an average rate of 23 miles a day. As the railroads are under government control, all arrangements for transportation of troops and supplies are easily made so that regular traffic is interfered with but little. No tents are carried, the troops being billeted on the inhabitants at prescribed rates or going into bivouac. Large wagon trains are therefore not needed. What wagons are required to carry supplies from the depots to the troops are requisitioned in the district. The troops are in heavy marching order and carry their heavy packs without fatigue. This is because they are trained to it, habitually carrying their packs in all military exercises throughout the year. The concentration having been effected, the troops are organized into two armies, each with a general in command selected by the emperor. For convenience, each army is given a temporary designation, as the Red Army, the Blue Army.

A general war situation is announced. The Red Army is supposed to be an invading army and to advance across the frontier with some important city as an objective. The Blue Army is on the defensive. The armies are at the beginning many miles apart, the whole theatre of operations covering perhaps 60 or 70 miles square. Each commanding general makes his dispositions, posts his troops, and issues such orders as he thinks necessary. Beyond a knowledge of the general scheme, he knows nothing about the movements or location of the enemy except what he finds out from reconnoissances, spies, etc., as in actual war. At the end of the first day's operations the results are determined by the director and the umpires and the general situation is summed up. The work of the day is criticised and, if necessary, the director gives the generals in command additional instructions for the following day. Each general then goes on with his plan or modifies it according to his instructions or the developments of the day, and issues his orders for the next day; and so on throughout the maneuvers. To describe clearly the operations day by day in detail throughout the maneuver period is impracticable without the assumption of a concrete case and the use of maps, so it will not be attempted. A feature of the maneuvers is often a charge upon infantry in position by the combined cavalry force. This is somewhat spectacular and would probably not be done under similar circumstances in war, but this fact is recognized by all concerned and the operation is therefore not misleading. It gives an opportunity to show the training of the cavalry and how it can be handled in large masses. As the director of maneuvers has absolute control of both sides, he can arrange the problems so that the maneuvers shall take place in the exact localities desired. The question of the location of supply depots at convenient places beforehand is therefore an easy one.

A large captive signal balloon accompanies the emperor's headquarters. It is distinguished from other captive balloons by a special flag. Signals are made by attaching to the balloon combinations of balls and inflated bags. These signals are known to all, can be seen for great distances and consequently orders can thus be transmitted to all the troops more quickly than in any other way yet devised.

Great attention is paid to sanitary conditions and in consequence the percentage of sickness is very small. Formerly in maneuvers much sickness prevailed among the troops due to the use of impure water. To guard against this a careful inspection of the water supply of the region is made beforehand, and placards are put up showing where water is to be had and its condition.

These maneuvers are of great value in training officers, especially staff officers. They also serve as a sort of examination for officers, whose work in the field comes under the observation of their superiors, from the emperor down. Officers showing zeal and ability are marked for advancement, while those whose work does not

come up to the standard are reproved or even more severely dealt with, officers whose handling of their men does not suit the emperor being often relieved from their commands. The maneuvers are terminated by a grand review before the emperor, all the troop taking part, after which they return to their garrisons.

American Maneuvers.— In the United States circumstances have heretofore prevented the carrying on of maneuvers as in Europe. Our army was so small and so widely scattered that a large enough force to make it worth while could not be brought together without great inconvenience and expense. Maneuvers on a small scale were had in Indian Territory in 1889, in which troops stationed within marching distance took part, but they were not again attempted until 1902, when the first of what it is hoped will be an annual series took place They marked, too, for the first time in the United States the participation of the National Guard in conjunction with regulars. In order to give a clear idea of how they are managed in the United States it will be best to give a brief account of the maneuvers of that year. They will be improved upon and developed as time goes on, but the work done then will serve as a basis. The place selected was the large military reservation of Fort Riley, Kansas. The department commander was selected to direct them. A board of officers was convened at Omaha beforehand to draw up plans for the maneuvers and rules for their conduct. Besides the garrison of Fort Riley, troops were ordered from posts in Kansas, Nebraska, Arkansas and Oklahoma. The troops from Arkansas and Oklahoma went by rail; the others marched. Marches were conducted with all the precautions that would be necessary in an enemy's country. The force collected comprised a battalion of engineers, three regiments of infantry, three squadrons of cavalry, five batteries of field artillery and detachments of the Signal and Hospital Corps. Invitations were sent by the war department to the governors of States to send National Guard troops to take part in the maneuvers. As the necessary expense was not at that time borne by the government, only two States, Kansas and Colorado, sent troops: the former, two regiments; the latter, one battalion. Many National Guard officers, however, were sent from their States as observers. Foreign military attachés were also invited. The troops had both blue and khaki uniforms. When divided into opposing forces, one wore blue, the other khaki, and they were designated as the Blues and the Browns, respectively. An officer was named as chief umpire, with a number of other officers as his assistants, one being chief umpire for the Blues; another, chief umpire for the Browns. A decision of an umpire on any point must be observed, but if any officer concerned should think it a wrong one, he could appeal from it after the maneuver. The rules provided that firing should cease when opposing forces came within one hundred yards of each other, and that cavalry charges should stop at the same distance. The greatest care was taken to see that no ball cartridges were carried by the men. Men supposed to be wounded were immediately taken care of by the Hospital Corps. Connection by telegraph and telephone was established and maintained by the Signal Corps. Poles were set up and wire strung as fast as troops marched, and any part of a force could be kept constantly in communication with any other part or with headquarters. A smoke signal bomb, which could be seen for long distances, was sent up at the conclusion of the operations each day and the troops were then marched back to their camps. The programme for the maneuvers provided for a series of military problems, varying in character from day to day, each being completed in one day. As the National Guard contingent did not arrive as soon as the regulars, they took no part in the operations of the first few days. There were nine problems during the maneuvers. Some of them will be briefly stated. In the descriptions "battalion" signifies a battalion (four companies) of infantry or engineers; "squadron", a squadron (four troops) of cavalry.

Problem 1. "The Blues represent the outposts of an army corps on the defensive, holding Fort Riley. Strength: 9 battalions, 1 squadron, 3 batteries. They are placed from right to left as an outpost line. The guns occupy commanding positions in the line and are sheltered by gun-pits constructed after their arrival in position. The line selected was judged very satisfactory and the time made excellent as the Blues marched three miles and then established their line four miles long in two hours and a half, the ground being heavy and the roads muddy. The Browns represent two reconnoitering parties of an advancing army corps. The first consists of 1 battalion, 1 squadron, 1 battery; the second of 1 squadron, and 1 battery. Approaching from different directions, they have orders to unite near Fort Riley for a demonstration against the enemy's position in order to ascertain his strength. The Brown batteries were ordered to locate and engage the hostile batteries. One opened fire at 3,000 yards. The other, through an error, came under fire, in column, at 1,400 yards. As the hostile batteries were under shelter while the Browns were in the open, the umpires decided that both Brown batteries had been put out of action. They also decided that the Brown infantry and cavalry were not handled aggressively enough for a reconnoissance in force, that the strength of the Blues had not been fully developed, and that the information gained by the Brown commander as a result of the reconnoissance would consequently have been misleading. The results of the day were in favor of the Blues.

Problem 2. Attack and defense of a convoy. The Blue army is operating about 50 miles southwest of Topeka, with that point as a base. The railroads are assumed to be broken up and supply by wagon train is necessary. One of the trains, consisting of 180 wagons, has camped about 25 miles from Topeka. A raiding force of the Browns has gotten in rear of the main Blue army. Its commander has learned of the train and plans its capture or destruction. The Blue escort consists of 6 battalions, 1 battery, 2 troops; the train is in two divisions. The commander expects to be attacked and moves out with advance and rear guards and with a half battalion on each flank of each division of the train. The remainder of his force, 2 battalions and 1 battery, is between the two divisions. The commander has orders to push on as rapidly as possible as the supplies are badly needed. The Brown raiding force consists of a platoon of artillery and 10 troops of cavalry. The op-

posing forces having come in contact, a series of detached actions ensue, the result being that the Browns are finally driven off after having destroyed 36 wagons. This is due to faulty disposition of the train, it having been, at one point, unnecessarily exposed to hostile artillery fire. With this exception the Blues were adjudged to have been in the main well handled. The Browns were criticised for not having thoroughly informed themselves of the enemy's dispositions, in consequence of which a portion of their force came unexpectedly upon a largely superior force of the enemy and was declared out of action. A charge was also made upon infantry in position, which should not have been done. Had the Browns, with their inferior force, acted with more caution, they could have kept up their harassing tactics and in the end have inflicted much more damage on the train.

Problem 3. This consisted of three separate exercises, each embracing the employment of a regiment as an outpost for an imaginary larger command. In each case the outpost was established by a regular regiment, National Guard officers accompanying the commander as spectators. Each outpost, when completely established, was relieved by a National Guard regiment. When a National Guard outpost was established a small force of regulars, representing an outlined enemy, attacked and the outpost made the necessary preparations for defense. For the instruction of the National Guard, great care was taken to explain the function of an outpost and the manner of receiving the attack. It was also explained that the attacking force was supposed to be superior in strength to the outpost. In the execution of these exercises the criticism was made that the tendency of the men was to hold on to their advanced positions too long, the idea of retreat being repugnant. Such a retreat, however, would have been necessary had the simulated attack been real, and in this case it was necessary for carrying out the exercise ordered. The object of the exercise, which was often lost sight of, was not to maintain a line of outposts under attack, but to show how entire outposts could be brought into united defensive action in order to give the main body time to make its dispositions. The unanimous opinion of the umpires was that the employment of a small number of men to represent a large imaginary force is unsatisfactory, and should be discontinued in future maneuvers. The situation is unreal and it is difficult to make the participants realize it.

In the evenings the officers were assembled and the events of the day were discussed. The board appointed to draw up plans for the maneuvers agreed that the most desirable form is that employed in Europe, where two large bodies, each operating from a definite base, move forward in the execution of a large strategical problem, occupying several days and covering a large extent of country. All the features of an active campaign are introduced and all the elements of tactics are brought in, but circumstances prevent it in the United States, as the necessary ground is not available within reasonable distances. The general prevalence of fences, which in agricultural districts of continental Europe are absent, prevent free movement over ground not owned by the government and their destruction or removal would be too expensive. The general opinion after the maneuvers was that they were instructive and valuable in the highest degree and were well worth the cost. The conditions of actual warfare were well maintained and show features were entirely eliminated.

Permanent Drill Grounds.— The Act of Congress of 2 Feb. 1901, authorized the secretary of war "to cause preliminary examinations and surveys to be made for the purpose of selecting four sites with a view to the establishment of permanent camp grounds for instruction of troops of the regular army and National Guard, with estimates of the cost of the sites and their equipment with all modern appliances, and for this purpose is authorized to detail such officers of the army as may be necessary to carry on the preliminary work." In accordance with this act four sites were selected, regard being had to geographical conditions, so that they would be available for as large a part of the army and militia throughout the United States as possible without undue expense for transportation of troops and supplies. The Militia bill, which became a law 21 Jan. 1903, contained the following provisions: "That the secretary of war is hereby authorized to provide for participation by any part of the organized militia of any State or Territory on the request of the governor thereof in the encampment, maneuvers and field instruction of any part of the regular army at or near any military post or camp or lake or seacoast defenses of the United States. In such case the organized militia so participating shall receive the same pay, subsistence, and transportation as is provided by law for the officers and men of the regular army, to be paid out of the appropriation for the pay, subsistence, and transportation of the army." "That whenever any officer of the organized militia shall, upon recommendation of the governor of any State, Territory, or general commanding the District of Columbia, and when authorized by the President, attend and pursue a regular course of study at any military school or college of the United States such officer shall receive from the annual appropriation for the support of the army the same travel allowances, and quarters, or commutation of quarters, to which an officer of the regular army would be entitled if attending such school or college under orders from proper military authority, and shall also receive commutation of subsistence at the rate of one dollar per day while in actual attendance upon the course of instruction." Congress having recognized the value of maneuvers and having made provision for them to be carried on, they may now be considered a permanent feature of our military system. The armed land forces of the country, regulars and militia, will hereafter be trained in practical military work together as they never have been in years gone by and the outbreak of another war should find the country better prepared to meet it than at any previous time in its history.

Naval Maneuvers may be tactical or strategical; the former having to do with the handling of fleets when they are within sight of each other, the latter when they are not. As all the elements, such as size and speed, character and arrangement of armor, number and power of guns, of different classes of ships, battleships, cruisers, and torpedo boats, are well

known, it is supposed, when they come in conflict, that the result will be a foregone conclusion, assuming the personnel to be of equal quality. The personal element, the man behind the gun, while of vital importance in war, is a factor that cannot be easily estimated in naval maneuvers. Much more attention is therefore given to strategical maneuvers. A fleet going out for maneuvers is divided into two squadrons, one to attack, the other to defend. A passive defense is not contemplated. While the object may be the defense of a harbor, the way to accomplish it is not to wait in port for the enemy, but to go out to seek him on the open sea. Otherwise the advantage of one of the most valuable characteristics of ships, their mobility, would be lost. A common form of strategical problem is to assign to the offense (Red squadron) the task of seizing and holding some harbor within a specified maritime district, to use as a base for future naval operations or as a landing place for accompanying troops. The object of the defense (Blue squadron) is to prevent this, nothing being known of the enemy's plans except that the harbor chosen must be within the prescribed limits. It may be anywhere along several hundred miles of coast. Rules for the maneuvers are prepared beforehand. It is assumed that if the attacking squadron can enter a harbor, unprotected by fortifications, and remain there a length of time specified without being discovered, it has succeeded. This will allow time to land troops and prepare for defense. It is like a game of hide and seek. The commander of the Reds, being well out to sea, decides that he will try to seize one of a certain number of harbors, knowing all those that would answer his purpose. He has to find one that is unguarded and unprotected. He uses his fastest vessels as scouts. His success depends upon the rapidity and secrecy of his movements. As the Blue squadron is supposed to be much the superior in strength, the Reds are assumed to have failed in their object unless they enter the harbor selected undiscovered, or if discovered, unless the main force of the Blues is at such a distance that it cannot arrive and attack the Reds within the time allowed them to establish themselves. The problem for the Blue commander is to discover the enemy, and having discovered him, to have his forces so disposed that he can concentrate for attack a force superior to that of the Reds. He too uses his fastest vessels as scouts. Defending a friendly coast, all aid possible is given him from shore. He can establish there as many lookout stations as he pleases. Every lighthouse is a watch-tower for him. He keeps in communication with his ships and with his shore stations. If he discovers the enemy and comes within range of him with a strong force within the time fixed he wins the day. A common form of exercise in all navies is that of torpedo boats against battle-ships or cruisers. The torpedo boats go out to sea and come in at night for attack, taking advantage of every means of concealment. If seen in time they could be destroyed at once. If they can come without discovery within torpedo range, the ship attacked is supposed to be destroyed. The ships are on the lookout and try to pick them up with their search-lights. When picked up a rocket is sent up from the ship. If the torpedo boat comes within the specified distance and no rocket has been sent up from the ship, she sends up a rocket. The vessel first sending up a rocket is the victor.

Combined Army and Navy Maneuvers.— In Europe combined maneuvers of the army and navy are varied in character. In one case the scheme may comprise the embarkation of troops, their conveyance in transports under convoy of a fleet to a supposed hostile shore, the forcing of a landing under cover of the fire of the guns of the fleet, and subsequent operations on shore. Such a scheme assumes the absence of seacoast fortification at the point selected for landing. Another case may be where a powerful fleet of battle-ships, cruisers, and torpedo boats is divided into two opposing fleets to act in conjunction with corresponding Red and Blue armies on shore, the combined forces of each side working together in accordance with a common plan. This scheme may involve naval engagements between the opposing fleets, attacks upon shore batteries by ships, the manning of seacoast forts, the throwing into them of strong detachments of infantry to act as supports and to prevent a landing by the enemy, the landing of naval brigades composed of sailors and marines to reinforce troops on shore, and many other incidents.

In the United States combined army and navy maneuvers were inaugurated in 1902. The seacoast is permanently divided into artillery districts. One or more of these districts are chosen as the zone of operations. In 1902 the zone included the coast from Buzzards Bay to New London and the forts at the eastern entrance of Long Island Sound. As the ordinary garrisons are insufficient for war conditions, they are reinforced by artillery troops from stations without the zone and by militia artillery, New York and Massachusetts having regiments that have been trained in artillery work. War conditions are simulated as closely as possible. The ships to form the hostile fleet are designated. Their number and character are known to the defense. This knowledge can be assumed because particulars of the navies of all nations are published in books and are accessible to all the world; witness the accurate knowledge of the composition of the Spanish fleets in 1898. The defense knows also the date of sailing of the fleet from a supposed foreign port and the probable time of arrival in the zone of operations, but knows nothing of the enemy's plans. They may comprise attacks by day or by night and attempts to run by the forts. The fleet has, of course, charts of the waters in which the maneuvres are to take place. The location of the forts, their character, and something of their armament are known. Buoys indicating channels are supposed to be removed and lights in lighthouses extinguished. If hulks are supposed to be sunk in channels as obstructions, the naval commander is informed of them. He must count on the presence of torpedoes. An army officer as umpire and a navy officer as observer are detailed for each fort, and a navy officer as umpire and an army officer as observer for each ship. A board of arbitration to consider all questions and render decisions is composed of two army officers, two navy officers, and a fifth member selected by the other four. When ships and forts are exchanging fire with blank cartridges it is impossible to estimate results at the time. Accurate accounts

of everything done are therefore kept in forts and on ships and detailed reports are prepared for the board of arbitration. On these the board bases its decisions. In these are noted arrival within range, whether by day or by night, the time under fire, the number of shots fired from each gun, the targets selected, and so forth. Tables are prepared beforehand giving the value, in points, of the fire from each kind of gun. These are based on data obtained from previous target practice records. As ship's guns are fired from a moving platform their fire is considered less accurate than that of land guns. Night firing is less accurate than day firing. The rapidity of fire ranges, say, from six seconds between shots for the smallest rapid-fire to two minutes between shots for the 12-inch seacoast guns, the largest used. The fire of the smaller calibre guns may silence, but not destroy, unless used in conjunction with those of larger calibre. The rules for the maneuvers are formulated with a view to meet the circumstances and incidents likely to arise in an attack by a hostile fleet on the harbors of the United States. They are based on the assumption that the primary object of the maneuvers is to investigate certain systems and problems of attack and to test the training of the personnel and the efficiency of the material. Much work preliminary to the maneuvers must be done by the defense. Signal stations must be selected. All the works of the defense must be put in telegraphic or telephonic communication with each other and with the signal stations. The commander must be constantly in touch with all parts of his line. Mines must be placed in position and tested. As a ship of the navy in commission is always on a war footing, not much of this preliminary work is necessary. Let us suppose ourselves on shore and the hostile fleet sighted. The shore commander is at his post in communication with his subordinates. He selects the target and prescribes the kind of fire. The men are at the guns; the range-finding, ammunition-serving, and signal details are at their posts. The range-finder details send in the range, direction, and course of the hostile ships. Firing is begun with the heavy guns as soon as they come within range. Their object is to disable the ships. Efforts are made to fire as many shots as possible while the ships are within range. If they are running by, the time is short and every shot counts. Their fire is so accurate that a line shot can always be counted on. The elevation to be given is entirely a matter of mathematical calculation, and is given for different ranges in tables ready at hand. A shot can be dropped at any range desired, and if the range is correctly given the percentage of hits is large. When it is considered that a 12-inch shot, weighing 1,000 pounds, will, for a range of six miles, go up about half a mile in the air, the importance of correct range-finding will be appreciated. If the shot drops in the right spot a battle-ship costing millions to build and taking years to complete may be disabled. If not, the shot is wasted. History shows that land fortifications suffer but little from the fire of ships. If the ships come closer, the rapid-fire guns come into play. Their objectives would be the parts of a ship not protected by armor and the crews. The mines, which constitute one of the elements of defense, contain only dummy charges, but they are electrically connected with a shore station, and if a ship comes in contact with a mine the circuit is closed, a fuse on shore is blown, and the ship is considered out of action. At night the search-lights are kept constantly at work to detect ships if they approach and to throw beams of light upon them so as to make clearer targets. All the incidents of the day on the ships and in the forts are summed up in the reports, and on these reports are based the decisions of the board. Throughout the maneuvers the fleet endeavors to accomplish its object, seeking out weak points in the defense and undefended lines of approach, or trying to run past in a fog or under cover of darkness. As the forts are stationary, they must wait until the enemy comes within range. Night and day the utmost vigilance must be exercised. If the scheme for the maneuvers should give a torpedo boat flotilla as an adjunct for the defense or if it should contemplate the landing of troops from transports convoyed by the fleet, to seize a position on shore at a place not protected by forts, necessitating on the part of the defense an additional infantry supporting force to oppose landing parties, the plans of the respective commanders would be modified accordingly. The decision as to whether the fleet or the land forces win is of minor importance. The maneuvers are of great value to both the army and navy. For the former they give instruction in the most efficient means of coast defense, including the co-ordination of all its various elements; the best system of fire control; the best location and employment of search-lights and range-finders; the best means of obtaining and transmitting information. They serve to point out any defects in the location and plans of the fortifications, and whether the number, type, and mounting of guns are the best adapted for the purpose at any particular site. For the navy they afford a test of the means of obtaining the ranges of the forts and batteries, and of conveying the information to the officers in charge of the guns. They give information as to the effect of mines and obstructions in impeding the movements of ships and the methods to be used in forcing such a passage or in removing the obstructions. They give instruction as to the best manner of approach and of maneuvering under fire, the formations to be used, the speed, and the distance between ships; the method of attacking by night or in a fog; the use of the search-light for lighting the target or blinding the eyes of the enemy's gunners or range-finders. The maneuvers rouse the interest and stimulate the *esprit de corps* of the personnel of both services and teach it to make the best use of the material placed in their hands under conditions as nearly as possible like those of actual war.

Col. W. A. Simpson,
Asst. Adjt.-Gen. U. S. Army.

Army Transport Service. At the outbreak of the war with Spain the water transportation in the possession of the United States consisted of a few small tugs, ferry-boats, and launches. Suddenly confronted with the necessity of despatching armies across the seas, it is not surprising that some confusion and delay

were encountered in selecting, chartering, and assembling fleets capable of transporting troops, with their guns, animals, and impedimenta, to Cuba, Porto Rico, and the Philippine Islands. To convert the vessels composing the several fleets from ordinary freight-ships into commodious and comfortable troop-transports required time and much outlay. The arrangement of sleeping accommodations for the men, stalls for the animals, increased water-supply, and ventilation involved a practical reconstruction of the interior of every vessel. It was particularly necessary to have those vessels destined for the Philippines made safe and comfortable, for it was anticipated that the troops might pass direct from the decks to the battle-field. Hospital ships were fitted out as quickly as possible, and served a useful purpose during the time of greatest need.

It was apparent at the outset that the problem of water transportation required careful and continuous study, and immediately after the surrender of Santiago de Cuba a division of transportation was created by the secretary of war and charged with supervision and control of all rail and water transportation; with the inspection of ships with reference to charter or purchase for use as transports, and with the arrangements for sending troops by rail to and from the various ports. When it became apparent that vessels would be required for a prolonged period, and that it was a very expensive proceeding to alter chartered vessels, the department began to purchase such ships as seemed best adapted to use as transports. Aside from the mere act of affording a passage to troops across the seas, the question of furnishing them supplies after landing involved many intricate problems, each requiring a special solution. American troops submit cheerfully to any amount of necessary hardship, but consider themselves entitled to the best of everything, regardless of cost, when the emergency has passed. For supplying their needs, it was necessary to construct refrigerator compartments in the transports to carry fresh beef and other perishable stores to the most remote and hitherto little known islands of our new possessions.

During the first few months of the heavy demands for transportation, the quartermaster's department was much hampered because vessels of foreign register could not be employed for the service, and Congress refused to grant American register to such vessels. Nevertheless, by 1 July 1898, 43 chartered vessels had been secured and fitted up for the transportation of troops, animals, and supplies. The difficulties and expense attendant upon securing efficient service with chartered vessels led to the gradual substitution of transports purchased by the government and permanently fitted up as troopships. The largest and best transports averaged nearly 6,000 tons capacity; and when, after some practical experience, a general plan of fitting up had been adopted, the transport service became a prominent feature of army administration, and attracted the attention and admiration of the civilized world. The urgency of the situation on the Pacific compelled a continuance of the charter system; but a fleet of government transports was gradually put in commission on the Atlantic, and as soon as the withdrawal of the volunteer army from Cuba permitted, many of the transports were sent to Manila by way of the Suez Canal and put on the San Francisco-Manila route. The Grant, Sherman, and Sheridan were the first vessels fitted out for this service, and their sailing from New York for Manila marked a new era in the occupation of the Philippines. The character of these transports may be comprehended by the statement that the Grant sailed from New York on 19 Jan. 1899, with the Fourth U. S. infantry and one battalion of the Seventeenth U. S. infantry, with a total strength of 50 officers and 1,703 enlisted men. The Sherman sailed on 2 February with the Third U. S. infantry and one battalion of the Seventeenth U. S. infantry, with a passenger list of 1,812 persons, followed by the Sheridan on 19 February with the Twelfth U. S. infantry and the Third battalion, Seventeenth infantry, with a total passenger list of 2,017 persons. These vessels made the long voyage to Manila with such success and comfort that the regiments were enabled to enter immediately upon active service. The experience of these voyages dictated some valuable suggestions, which were availed of at once in making desirable changes to perfect the transport service generally.

The large number of troops remaining in Cuba and Porto Rico after the return of the main body of regulars and volunteers necessitated the establishment of a regular line with weekly sailing dates. Advantage was taken of the regular steamship lines as far as possible for the larger movement of returning troops. The transportation to Spain of the Spanish prisoners was accomplished under contract, in accordance with stipulations under which the surrender of Santiago took place. More than 22,000 Spanish prisoners were thus returned from the eastern end of Cuba to Spain within 60 days of their surrender, in an economical and apparently satisfactory manner.

The outbreak of the insurrection in the Philippines made it necessary to hasten relief to the volunteer regiments still held in those islands, and the presence there of the old Spanish garrisons which, under the terms of the treaty of peace, were entitled to repatriation, made it desirable that they should be returned to Spain without delay. The transport service was strained to the utmost limit, but fulfilled its part in the most gratifying manner. During its first year of existence a total of 202,587 passengers were transported across the seas by army transports without responsibility for the loss of a single life.

The question of transportation of animals was one requiring much study and experiment, for there was little experience available to guide the department in a solution of the problem of landing cavalry horses in fit condition for service after a voyage of 7,000 miles. Some discouraging losses of mules occurred at a critical moment in the campaign against the insurgents, but gradually the system was perfected and the loss of animals actually reduced below the percentage of loss from injury and disease which should be expected in the herds on shore. Nearly 20,000 animals were transported during the year ending 30 June 1901.

At a time when every effort was being put forth to meet the requirements of the military situation Porto Rico was devastated by a hurricane, and the transport service was called upon to distribute relief stores to the unfortunate in-

habitants who, just released from the worries of war, found themselves threatened with famine and pestilence.

As conditions in the Philippines gradually settled down to a guerrilla warfare, the troops were distributed at about 400 stations, necessitating an inter-island transport service. Just as everything was becoming adjusted to the new conditions which followed the dispersal of Aguinaldo's army, the unfortunate "Boxer" outbreak took place in China. The experience already obtained enabled the department to handle the transportation question in such a way as to win the admiration of all the foreign contingent composing the Chinese relief expedition which finally entered the sacred city of Pekin.

As the insurrection gradually died away, and the volunteers who enlisted for Philippine service in 1899 were brought back to the United States, the number of transports was reduced by disposing of the least efficient in respect of economy as well as of carrying capacity. The vessels remaining in service represent the finest types of transports ever in the service of any nation. They contain all the improvement that several years of wide experience seemed to justify. The record of the army transport service reflects credit upon the War Department. The remarkable freedom from accidents and loss of life indicates a high degree of efficiency and discipline in the officers and crews of the transport fleet. The records show that considerably more than 500,000 passengers have safely crossed the seas in the army transports. The movement of such a vast number of people, many of them over the sea from 7,000 to 11,000 miles, without the loss of a passenger chargeable to the transport service, is a record which compares most favorably with those of all the great commercial lines which, through long experience, have reduced the transatlantic passenger traffic to an exact science.

The army transport service has withdrawn its fleet from the Atlantic, and has materially reduced the number of vessels in commission on the Pacific. The success of the service having become widely known, at the session of 1902–3, an act was passed providing that it should not be abandoned without the consent of Congress. The experience of these recent years justifies the belief that, if our government shall be again confronted with the direful necessity of organizing and transporting armies across the seas, there will be no repetition of the scenes and incidents which characterized the early days of the war with Spain. If these expectations materialize, the great expense and labor incident to putting in commission the magnificent fleet of ships under the army transport service will not have been in vain.

William H. Carter,
Brigadier-General General Staff.

Army War College, a department of the United States military educational establishment, authorized by Congress in 1900. Brig.-Gen. William Ludlow was made chief of the board which drafted the regulations. Its general purpose is the unification of the systems of instruction at the four existing service institutions; the development of these systems; and the most advanced professional study of military problems. The officers of the college exercise a general supervision over the course of study in each of the present service schools. This supervision extends to all civil institutions to which the government details an officer for military instruction. The faculty of the college study the military organization of the United States with an eye to a complete understanding of its practical efficiency of operations, and constitute an advisory board to which the secretary of war can turn at any time for details and recommendations as to any point in the mechanism of the whole military service. The study of plans of campaigns by the college and the accumulation of military information make the inauguration of a campaign, in case of war, only a matter of the issuing of the necessary orders by the secretary, as all the requirements will have been carefully studied out beforehand.

Army-worm, the caterpillar of the moth *Leucania unipunctata.* The adult measures about one and a half inches across the expanded wings, which are dull brown, the anterior pair bearing near the centre a small white dot which has suggested the specific name. Like most moths, this species flies at night and in seasons when they are specially abundant, are the most commonly captured insects at lights and baits of sugar or syrup, of which they are very fond. The eggs are usually concealed on herbage in fields, especially where vegetation is luxuriant, as in wheat fields. Unless checked by enemies the caterpillars quickly reach maturity, pupate a short time under ground, emerge, pair, and lay eggs from which a larger brood than the first is hatched. This brood, after devouring every green thing soft enough to eat, spread destruction as they march, army-like, from the place where they were hatched to fresh feeding grounds. When full grown these larvæ pupate; some for only a short time, others until the following spring. The former lay eggs for a third brood of caterpillars which endeavor to pass the winter as larvæ, so that larvæ, pupæ, and adults may be found throughout the year. The caterpillars attain a length of about two inches, are dark gray, striped with light yellow and green. Though annually common east of the Rocky Mountains they are generally so well controlled naturally that their depredations are insignificant, and usually when they do become a pest their enemies so quickly master them that they very rarely are troublesome in the same locality two years in succession. The most important of these enemies are fungous diseases and, especially, parasitic insects. Artificial controls are almost all mechanical. Occasionally the larvæ of the first brood may be noticed in time to apply an insecticide (q.v.) such as Paris green mixed with soap-suds instead of water to make it more adhesive to the grass; but usually the safest plan is promptly to bury the crop by plowing, or to burn it. If migration has started, a strip of land should be plowed across the line of march, harrowed, and rolled constantly to crush the worms, or kerosene emulsion, diluted only five times, must be sprayed upon the advancing worms and also upon their recent feeding ground. The name army-worm is given to other species of caterpillars, especially to *Laphygna frugiperda,* which is better known as grass-worm. Consult 'Third Report' United States Entomological Commission (Washington 1883); 'Bulletin 133' Cornell Experiment Station.

Arna, or **Arnee**, är'nē, a large animal of the ox genus, a native of India and the Indian Archipelago. See Buffalo.

Arnauld, är-nō', an ancient noble family, among whose most distinguished members are the family of Auvergne. (1) Angelique: b. Paris 24 Nov. 1624; d. 24 Jan. 1684. She was the granddaughter of the great Arnauld and was abbess of the famous nunnery of Port Royal from 1678. See Lives by Martin (1876); Monlaur (1901). (2) Antoine: b. Paris 1560; d. 1619. He was a zealous defender of the cause of Henry IV., and was distinguished for several political pamphlets, and for his powerful and successful defense of the University of Paris against the Jesuits in 1594. He drew on himself the hatred of the Jesuits, but was esteemed the greatest lawyer of his time. His numerous children formed the nucleus of the sect of the Jansenists (see Jansenius) in France. (3) Antoine, called the "Great Arnauld," youngest child of the lawer Antoine Arnauld: b. Paris 6 Feb. 1612; d. Brussels 9 Aug. 1694. He devoted himself to theology, and was received in 1641 among the doctors of the Sorbonne. In the same year he attacked the Jesuits in two works, 'De la fréquente Communion' and 'La Théologie Morale des Jésuites,' the first of which occasioned much controversy, because it applied the principles of the Jansenists to the receiving of the sacrament. After 1650, when Jansenism had become an object of public odium and the watchword of an important party in the state, Arnauld engaged in all the quarrels of the French Jansenists with the Jesuits, the clergy, and the government, was their chief writer, and was considered their head. The intrigues of the court occasioned his exclusion from the Sorbonne (1656), and the persecutions which compelled him to conceal himself. After the reconciliation between Pope Clement IX. and the Jansenists, in 1668, he appeared in public, and enjoyed the homage which even the court did not refuse to his merits and talents. He now attacked the Calvinists in many controversial tracts ('Renversement de la Morale de Jesus Christ par les Calvinistes'; 'L'impiété de la Morale des Calvinistes,' etc., and with his friend Nicole composed the great work, 'La Perpetuité de la Foi de l'Eglise Catholique touchant l'Eucharistе,' in opposition to them. On account of the new persecutions of the court, or rather of the Jesuits, he fled, in 1679, to the Netherlands. He was a man of a vigorous and consistent mind, full of solid knowledge and great thoughts; in his writings, bold and violent to bitterness, undaunted in danger, and of irreproachable morals. His works were published at Lausanne between 1775 and 1783, and again at Paris in 1843. (4) Jacqueline Marie, sister of the preceding, a French nun better known as Marie Angélique de Sainte Madeleine. She was famed for piety and was prominent among the Jansenists. She was prioress of Port Royal. See Life by Martin (1873).

Arnauts, är'nâts, or **Albanians**, a people of mixed origin, who have spread in the western part of European Turkey, along the coasts of the Adriatic and Ionian Seas. They call themselves *Skipetars*, that is, inhabitants of the mountains; by the Turks they are called *Arnauts.*. Their language is regarded as a descendant of the ancient Illyrian language, and contains a considerable admixture of Greek, Roman, German, Slavonic, and Turkish words. The Arnauts in the coast towns generally speak Greek as well as their own language. They are divided into several tribes, among whom the Suliotes in the south are partly of Greek origin. As regards religion they are divided between Christianity and Mohammedanism. They are frank toward friends and superiors, but indulge in every kind of artifice and perfidy toward their enemies. The Tosks of southern Albania have in some respects not so good a reputation as the Gheggas of the north, but, owing to their contact with Greece, they are further advanced in civilization. War is the favorite occupation of the Arnauts. For arts and trades they have no inclination. Agriculture they esteem not so honorable an occupation as arms. They form the finest body of troops in the Turkish army.

Arn'hem, or **Arnheim**, a town in Holland, in the province of Gelderland, on the right bank of the Rhine. It was once fortified, but the fortifications have been converted into public walks. The environs of Arnhem being more agreeable than those of almost any other town in Holland, it is much frequented by summer visitors. Among the chief buildings may be mentioned the Groote Kerk, or high church, containing the fine monument of Charles, Duke of Egmont; the Prinzenhof, the town-house, and the barracks. Its manufactures consist of cabinet wares, mirrors, carriages, mathematical and physical instruments, etc., and there are numerous paper-mills in the neighborhood. Its trade, partly direct in grain, and partly transit to Amsterdam, Rotterdam, etc., is important. In 1795 it was stormed by the French, who were driven from it in 1813. Pop. (1900) 56,812.

Ar'no (anciently *Arnus*), one of the largest rivers of Italy. It divides Tuscany into two parts, and rises in the Apennines, on the east of Florence, on the border of Romagna, 15 miles west of the sources of the Tiber. It then turns southward toward Arezzo, after which it runs westward through Florence, and enters the Mediterranean four miles below Pisa. From any hill in the neighborhood of Florence the view into the valley of the Arno is charming. The entire course of the river is about 140 miles.

Arnold, Abraham Kerns, an American soldier: b. Bedford, Pa., 24 March 1837. He was educated at West Point, and commissioned 1st lieutenant, Fifth Cavalry, 17 July 1862. He was brevetted captain for gallant and meritorious service in the battle of Gaines' Mill, Va., and major for similar service at the battle of Todd's Tavern, Va. He received a Congressional medal of honor for gallantry in action at Davenport Bridge, Va., 18 May 1864. He commanded the field operations in southeastern Arizona against the Apaches in 1879, and against the Crows in 1887. During the Spanish-American war he commanded the 2d Division of the 7th Army Corps in Cuba. He has written 'Notes on Horses for Cavalry Service' (1869).

Ar'nold, SIR **Arthur,** an English statesman and author: b. 1833; d. 1902. He acted as assistant commissioner to administer the Public Works Acts during the cotton famine, 1863–6, and afterward wrote 'The History of the Cotton Famine.' Other literary productions have been: 'From the Levant' (1868); 'Through Persia by Caravan'; 'Social Politics'; and 'Free Land.' He sat in Parliament as a Liberal member for Salford, 1880–5. Established and was president of the Free Land League from 1885 to 1895; was chairman London County Council, 1895 and 1896, and was knighted in June 1895. He was a brother of Sir Edwin Arnold (q.v.).

Arnold, Benedict, a colonial governor of Rhode Island: b. England, 21 Dec. 1615; d. 20 June 1678. He was a leader of the opposition to Samuel Gorton's settlement at Pawtuxet, 1641. His knowledge of Indian languages enabled him to effect important negotiations with the Indians in 1645. In May 1657 Arnold succeeded Roger Williams as president of the colony, and upon the granting of the royal charter to the colony in 1663, was made the first governor, being re-elected in 1664, 1669, 1677, 1678. He took an active part in the reconciliation and union of the two colonies of Rhode Island and the Providence plantations. The famous windmill at Newport, whose erection was long ascribed to the Northmen, appears to have been built by him.

Arnold, Benedict, an American general, commonly known as "The Traitor": b. Norwich, Conn., 14 Jan. 1741; d. London, Eng., 14 June 1801. He descended from a leading Rhode Island family; was fairly educated. He was early noted for athletic prowess, reckless daring, and resource, and as a man displayed a proud, passionate, uncontrolled nature, quickly responding to affection or resentment. He became a druggist and bookseller in New Haven at 21; prospered, and embarked in the West India trade. At the news of the battle of Lexington, he armed a body of 60 volunteers, marched to Cambridge, and proposed the capture of Ticonderoga and Crown Point. The Massachusetts Provincial Congress gave him supplies therefor, a commission as colonel, and authority to raise troops; but finding at his recruiting ground that an expedition had already started, he hastened after it and claimed command under his commission. As the commander was Ethan Allen, both Allen and the troops declined to pay any attention to it; and Arnold under protest accompanied it as a volunteer, and entered Ticonderoga beside Allen. Four days later he was joined by a band of his own, and at once sailed down Lake Champlain and captured St. John's.

Refused the command of the captured forts, he returned to Cambridge, proposed to Washington an expedition against Quebec, and on 11 September left for the Kennebec with 1,100 men, to cross the divide between its headwaters and the early Chaudière. After a fearful march through sleet storms, frozen lakes, rapids, and forests, he reached Quebec 13 November, scaled the heights to the Plains of Abraham, and dared the garrison of thrice his numbers to come out and fight. They refused, and reinforcements from Sir Guy Carleton compelled him to fall back. On the arrival of Montgomery the two undertook an assault (31 December) in which the latter was killed and Arnold's leg shattered, but he still blockaded the place till relieved by Wooster in April. Meantime he had been commissioned brigadier-general and given command of Montreal. On the expulsion of the United States troops from Canada, the British planned an invasion by way of Lake Champlain, and Arnold went to Ticonderoga and spent the summer building a fleet to bar their way. On 11 October he fought one of the most obstinate and heroic naval battles in our history, near Valcour Island off Plattsburg. Hopelessly outnumbered, he nevertheless escaped with the most of his boats and all of his men. The British retired to Montreal, and the Americans sent Washington the 3,000 men which enabled the battles of Trenton and Princeton to be fought.

One of Allen's men, whose promotion had been opposed by Arnold on the ground that he had plundered officers' baggage in Canada, brought counter-charges of malfeasance against him in December, which the board of war pronounced "cruel and groundless." But Congress in making five new major-generals, 19 Feb. 1777, passed over Arnold, the senior brigadier, on the ground that Connecticut had two already, and appointed Stirling, Mifflin, St. Clair, Stephen, and Lincoln, all of whom together had not a tithe of Arnold's abilities or achievements. He had a right to be enraged: but he contented himself with asking to be made ranking officer as before; offered to serve under his juniors for the present; and in Tryon's invasion of Connecticut in April, did such splendid deeds that Congress for very shame gave him the major-generalship, but still left him at the foot. Meantime he was in pressing need of having his claims against Congress settled. Pay and supplies were hard to extract from that body, and Arnold, in his Canadian expedition and elsewhere, had used his own money freely and pledged his credit repeatedly to keep the movements from utter collapse for lack of them. But the claims were large, Congress was suspicious and dilatory, Arnold's business was half ruined, and he needed the money. He was at Philadelphia, seeking restoration of his rank, and, his patience exhausted at the refusal of Congress to act in his behalf, had asked permission to resign, when Burgoyne's invasion of 1777 loomed up imminent, and Washington wrote urgent and repeated requests to Congress to send Arnold north to oppose him. Soothed by this flattering request, he withdrew his resignation and hastened north. In this crisis, it is to him that the country owed its salvation. By a decoy messenger he scattered St. Leger's army in a panic, its Indian allies turning against it and butchering the whites as they retreated. He then foiled Burgoyne's flanking attempt at Freeman's farm 19 September, unsupported by Gates, and in the final battle of 7 October, took command without official right, and routed Burgoyne's army. This victory gained for the United States the French alliance, and ultimately the surrender at Yorktown. During the engagement Arnold's leg was shattered and he remained in Albany disabled till spring. On 20 Jan. 1778, Congress restored him his senior rank.

In June he was given command of Philadelphia, where he became engaged to a beautiful girl of a loyalist family, Margaret Shippen. The testimony is conclusive that she had nothing to do with his fall; but her family and the always powerful loyalist society of Philadelphia had for the next two years a great influence over him. The prospects of the United States grew so bad that even Washington wellnigh lost all hope; the English government offered such seductive proposals that many patriotic citizens considered it wanton wickedness to prolong bloodshed and misery, when all that the war was waged to obtain was offered with fair guarantees. Congress was so faction-ridden and incompetent that many more thought the future of independence most calamitous even if it could be obtained; the soldiers were unpaid and unclothed, deserting fast, and nearing a dangerous mutiny which soon broke out. In this state of things, every influential officer at odds with Congress was besieged with expressions of loyalist opinion, and Arnold was in the thick of all that could shake his resolution. As always, he lived beyond his means, and as always he was in bitter feud with the other powers. He had determined to retire and settle on a New York land grant, when he was assailed with a series of charges by the State authorities, headed by Joseph Reed, president of the executive council. Most of the charges were frivolous, but two,— that he courted the loyalists at the expense of the patriots, and that he had used his position to make illegal purchases,— were serious. A committee of Congress acquitted him absolutely except on two foolish counts, and advised ignoring them. Arnold was satisfied and resigned his command. Reed protested on the ground that he had more evidence, a fresh committee referred the charges to a court-martial, and Arnold spent month after month urging a speedy trial. Reed with equal pertinacity delayed his "evidence" till more than a year after the first indictment; the court-martial returned its verdict 26 Jan. 1780. The court returned the same verdict as the committee, but recommended that Arnold be reprimanded for two frivolous counts, and Washington was compelled to discharge this odious office. He did it in the mildest of terms, however, and offered Arnold the post of honor in the next campaign.

But it was too late: the public disgrace imposed on Arnold after his magnificent services, wounds, and losses filled him with determination for revenge, justified to himself by the reasons above stated. Inviting examples were put before him: chiefly of Monk, who had restored Charles II. and been rewarded by honors and gratitude; more pertinently, of Marlborough's betrayal of James II. by taking his whole army over to William; and others. He really seems to have argued himself into believing that he should be playing the part of a patriot by ending the war at a blow, restoring peace and prosperity, giving the colonies a much better government than they had now or before the war, and practically secure independence under the English offers; and that this once done, all parties would thank and honor him, as he could control negotiations with the English government. This decisive blow would be the putting of the English in control of the Hudson, gaining at a stroke the object of Burgoyne's and other campaigns,— severing the New England colonies from the rest, and giving the enemy New York, the central colony. For this end he asked of Washington the command of West Point, the key of the Hudson, with its mass of military stores: the colonies could hardly hold out after such a loss, aside from the strategic gain. He pleaded ill health for asking this instead of the proffered command; and Washington accorded it to him. After the capture of André he escaped to the Vulture, and issued a proclamation justifying himself and asking his countrymen to do likewise, making glowing offers to deserters. The British made him a brigadier-general, and on 20 December he sailed for the James River, where he burned Richmond, intrenched himself for the winter at Portsmouth, and in June 1781, returned to New York. In September he was ordered to raid New London, Conn., 14 miles from his birthplace. He burnt a quantity of shipping and stores, which set fire to and partially destroyed the town; and the "massacre" of Fort Griswold was achieved by a detachment on the other side of the river Thames.

Shortly after the surrender of Cornwallis in October, he was sent to London to confer with the ministry on the further conduct of the war. The king and the court received him well; but the Liberals denounced him as bitterly as the Americans, and a large share even of the Tories distrusted a renegade and detested a betrayer of his trust. The officers in the British army despised a colonial as heartily as in Braddock's days, and therefore it was found impossible to give him the employment in the army he eagerly coveted. In 1787 he removed to New Brunswick and engaged in the West India trade, with two sons; but in 1791 he returned to London. The next year he fought a bloodless duel with the Earl of Lauderdale, for a stinging insult of the latter in debate in the House of Lords. In 1794 he went to the West Indies to settle, but the Anglo-French wars made it impossible, and he was twice extricated from great personal danger by his alert resource. He rendered great service to the British commanders and in 1795 was thanked by the committee of West India planters, with the wish that he might remain in public service. He also formulated plans for the British capture of the Spanish West Indies; and in 1798 asked for military service, but his request was not granted, even after personal solicitation. The refusal helped greatly to break him down; his unthrifty habits had drained his purse, and he had intense pecuniary embarrassments. He was active in fitting out privateers, a speculation which gave him more anxiety than profit; and he died at 60, a worn-out, harassed, unhappy man, seeing that his crime was also a colossal blunder. But that he had first saved the country he tried to ruin, that he was grossly wronged and greatly tempted on his best as well as on his worst side, and that he deserves far more pity than hate, cannot be doubted. See 'Lives' by Sparks (1838); I. N. Arnold (1880); **Todd (1903).**

Ar'nold, Sir Edwin, English poet and journalist: b. Gravesend, 10 June 1832; d. 24 March 1904. He graduated from Oxford in 1854; taught for a while in Birmingham; and became principal of the Sanskrit College at Poona, near Bombay, where he rendered important ser-

vice to the government during the great rebellion in India. Returning to London in 1861, he joined the editorial staff of the *Daily Telegraph.* He has twice visited the United States on lecture tours. Of his original poetry, inspired by Oriental themes and legends, the most famous work is 'The Light of Asia, a Poetic Presentation of the Life and Teaching of Gautama' (1876); 'Indian Idylls' (1883); 'Pearls of the Faith'; 'Sa'di in the Garden'; 'The Light of the World'; 'Potiphar's Wife and Other Poems'; 'India Revisited'; 'Japonica'; and 'The Tenth Muse and Other Poems'; 'East and West' (1896); 'The Voyage of Ithobal' (1901), are among his many works. The popularity gained by 'The Light of Asia' has not been sustained by the appearance of his later work.

Ar'nold, Edwin Lester, an English author, son of Sir Edwin Arnold. He has written 'A Summer Holiday in Scandinavia' (1877); 'On the Indian Hills, or Coffee Planting in Southern India' (1881); 'Bird Life in England' (1887); 'England as She Seems' (1888); the novels 'Phra, the Phœnician' (1890), and 'The Story of Ulla' (1895).

Ar'nold, George, an American poet: b. New York city, 24 June 1834; d. New Jersey, 3 Nov. 1865. Adopting literature as a profession he contributed prose and verse to 'Vanity Fair,' 'The Leader,' and other periodicals of his day. The "Macarone" papers established his reputation as a humorist, and the 'Jolly Old Pedagogue' is his best known poem. During the Civil War he did military duty at one of the forts on Staten Island. His published volumes are: 'Drift: a Seashore Idyl' (1866); 'Poems, Grave and Gay' (1867); 'Poems'; ed. with a Biographical Sketch by Wm. Winter (1870).

Arnold, är'nōlt, **Hans,** the pseudonym of Bertha von Bulow. See BULOW, BERTHA VON.

Arnold, Isaac Newton, an American lawyer and author: b. Hartwick, Otsego County, N. Y., 30 Nov. 1815; d. Chicago, 24 April 1884. Admitted to the bar in 1835, he removed in 1836 to Chicago, where he resided the remainder of his life, engaged in legal practice and taking an active part in politics. From 1861 to 1865 he was a member of Congress, and had a prominent share in measures leading to the abolition of slavery. His ablest speech was on the confiscation bill, 2 May 1862. Upon his retirement from Congress President Johnson appointed him an auditor of the United States treasury. A lifelong friend and intimate of Lincoln, he wrote 'History of Abraham Lincoln and the Overthrow of Slavery' (1867; new ed. 1885). His 'Life of Benedict Arnold; His Patriotism and His Treason' (1879), is in the nature of an apologia. 'Recollections of the Early Chicago and Illinois Bar' appeared in 1880.

Arnold, är'nōlt, **Johann Georg Daniel,** an Alsatian dialect poet and jurist: b. Strassburg, 18 Feb. 1780; d. there, 18 Feb. 1829. His lyrics (in High German) are meritorious, but he is at his best in 'Pentecost Monday' (1816), a comedy in Strassburg dialect and rhymed Alexandrine verse, pronounced by Goethe "an incomparable monument of ancient Strassburg custom and language, a work which in clearness and completeness of intuition and ingenious delineation of detail can scarcely be equaled." He was a professor in the College of Strassburg and wrote a notable legal work entitled 'Elementa Juris Civilis Justinianei cum Codice Napoleoneo et Religuis Legum Codicibus Collata' (1812).

Arnold, är'nold, **Lewis G.,** an American soldier: b. New Jersey, 1815; d. 1871. Educated at West Point he served as second lieutenant in the second Seminole war (1837-8) and was in active service during the war with Mexico. He distinguished himself in the Federal army during the Civil War, retiring from the service with the rank of lieutenant-colonel of regulars in 1864.

Ar'nold, Matthew, an English poet and critic: b. Laleham, 24 Dec. 1822; d. Liverpool, 15 April 1888. A son of Dr. Thomas Arnold, the historian of Rome and famous head-master of Rugby, he was educated at Winchester, Rugby, and Balliol College, Oxford, where he gained the Newdigate prize for his poem 'Cromwell' (1843), and in 1845 was elected Fellow of Oriel College. For a short time he taught the classics at Rugby, then became private secretary to the Marquis of Lansdowne, 1847-51, who appointed him an inspector of schools, a post he held until 1883, when Gladstone conferred on him a civil list pension of £250, which enabled him to retire. While the routine and details connected with this work were ever distasteful to him, he performed them thoroughly and conscientiously, and his suggestions were not without influence on English secondary education. Three times he visited the Continent, commissioned officially to study school discipline and educational methods there, and his results were summed up in the three books: 'Popular Education in France' (1861); 'A French Eton' (1864), and 'Schools and Universities on the Continent' (1868). His official reports from 1852-82 were published by Sir F. Sandford and are of considerable educational interest and value. From 1857 to 1867 he delivered the lectures connected with the Professorship of Poetry at Oxford. In 1883-4 and in 1886 he visited the United States, lecturing in the principal cities. In 1873 he took up his residence at Cobham where he remained till his death, which occurred suddenly from heart disease. In general his domestic life was most happy, but sadly clouded by the successive deaths of three promising sons.

It is as poet and critic that Arnold was best known in his own day and his poetry and criticism give him his distinguished position in English literature, a position which is bound to be regarded more highly by posterity than it was by his contemporaries. His poetry is more classical in form and atmosphere than that of any other English poet except Milton. But he is classical in a general sense only — not imitative nor affected. His classicism lies in his serenity and urbanity of mind and temperament; in his lucidity, in his Virgilian grace and dignity. In thought and suggestion he was frankly contemporary. If his poetry has a predominant note, it is that of pathos. 'Balder Dead' is a masterpiece of noble sadness and dignified narrative. 'Sohrab and Rustum,' with its perfect unity of action, ends in a situation of matchless pathos. Portions of 'Tristram and Iseult' are among the finest examples of descriptive poetry, and 'Thyrsis' is one of the most beautiful elegiac poems in the language. Some of his lyrics, too, are exquisite, for example, 'A Summer Night,' 'The Youth of Nature,' 'The Youth of

Man,' 'Isolation,' 'Faded Leaves,' and 'A Southern Night.' The 'Forsaken Merman' has passages of delightful fancy, and 'The Church of Bron' displays imagination of a high order. The great merit of his verse is its uniform level of fine thought, expressed with notable grace, clearness, and restraint.

As a critic Arnold has no superior and is without a rival in English literature. He made far less errors than Johnson, was better informed than Dryden, was broader and more judicial than Pope. His judgments upon our poets have become generally accepted and are rarely questioned. His view of what criticism should be is given in the well-known essay on 'The Function of Criticism at the Present Time'; in his own work and practice he seems to have conceived its duty to be "to lay down decisive canons of cultured judgment, to sift the sound from the vicious, to maintain the purity of language and of style." He greatly modified the accepted form of the English critical essay and brought it more into line with the French *causerie* as developed by Sainte-Beuve, whose influence on Arnold was considerable. His characterizations of Spinoza, Marcus Aurelius, and Heine are masterly, and his appreciations of Wordsworth, Byron, and Goethe are without equals. The essays 'On Translating Homer' are now classics. Homer's characteristics are nowhere else set forth with such understanding, sympathy, and authority, or the rules of translation so unanswerably deduced from them. His social, theological, and political criticism forms a distinct part of his work. He was thoroughly discontented with English indifference to ideas in literature, politics, and religion, and the absorption of his countrymen in material pursuits. He made it his duty to arouse them from their intellectual apathy, and urge their attention to the higher things of life and the spirit. As a consequence he was greatly misunderstood and received much unmerited criticism and contempt. But his ideas had a marked influence on his generation, and many of them have triumphantly prevailed. The books in which he carried on his crusade against British "Philistinism" were: 'Culture and Anarchy' (1869); 'Saint Paul and Protestantism' (1870); 'Friendship's Garland' (1871); 'Literature and Dogma' (1873); 'God and the Bible' (1875); 'Last Essays on Church and Religion' (1877). He repeatedly evinced a happy faculty for doing the right thing at the right moment. The storms of controversy and attack which his telling and keen criticism of manners caused, never ruffled him, or led him to retort in kind. His phrases became current coin, his cutting "labels" stuck to the things he satirized and have passed into permanent use. This gift of sending forth phrases to ring through and be accepted by a whole generation is a rare power. Forever associated with him in the sense in which he used them are the now proverbial expressions, "Philistinism," "the great style," "the young lions of the press," "the Zeit Geist," "the note of provinciality," "sweet reasonableness," "sweetness and light," "the stream of tendency, not ourselves that makes for righteousness." It was his expressed wish that he should not form the subject of a biography. In 1895 his letters from 1848 to 1888 were gathered and edited in two volumes by G. W. E. Russell. These were written almost entirely to members of his family and close friends, and show him in the happiest light.

Bibliography.—A bibliography of Arnold's writings was published by Thos. B. Smart in 1893. His poetical works appeared as follows: 'The Strayed Reveller, and Other Poems' (1849); 'Empedocles on Etna' (1852); 'Poems' (1853; 3d ed. 1857); 'Poems,' second series (1855); 'New Poems' (1867); and a complete edition in three volumes 1885. His critical works, beside those mentioned above, were: 'On Translating Homer' (1861-2); 'Celtic Literature' (1867); 'Essays in Criticism,' first series (1865); 'Mixed Essays' (1879); Irish Essays' (1882); 'Discourses in America' (1885); 'Essays in Criticism,' second series (1888). Contemporary literature is filled with criticism of the various aspects of Arnold's work. A few of the more important studies are: Fitch, 'Thomas and M. Arnold' (1897); Robertson, 'Modern Humanists' (1891); F. Harrison, 'Tennyson, Ruskin, and Mill, and Other Literary Estimates' (1900), an excellent appreciation; Brownell, 'Victorian Prose Masters' (1902); Walker, 'The Greater Victorian Poets' (1895); A. Galton, 'Two Essays Upon Matthew Arnold' (1897). Prof. Saintsbury's volume on Arnold is too hostile and unsympathetic to be of any critical value; and Mr. Herbert Paul's book in 'The New Englishmen of Letters' series is hopelessly futile and inadequate.

Ar'nold, Richard, an American soldier: b. Providence, R. I., 1828; d. 1882. He was graduated from West Point and served with distinction in the Federal army during the Civil War, being brevetted major-general of volunteers in 1865.

Ar'nold, Samuel, an English composer: b. London, 1740; d. 1802. In 1760 he was appointed a composer at the Covent Garden Theatre, and set to music the 'Maid of the Mill.' He also produced the oratorios of the 'Prodigal Son,' the 'Resurrection,' and others. He was made a doctor of music in 1773, and in 1783 was appointed organist of the chapel royal. He edited the works of Handel, in 36 volumes folio. In 1794 he was made organist at Westminster Abbey. In 1708 he composed his oratorio of 'Elijah.' Various as were his compositions, his inventive talent was but limited. His 'Cathedral Music' was published in 1790.

Ar'nold, Samuel Greene, an American historian: b. Providence, R. I., 12 April 1821; d. there, 12 Feb. 1880. He was graduated from Brown University in 1841, and traveled extensively in Europe, South America, and the East. He was lieutenant-governor of Rhode Island 1852, 1861-2, and sat for part of a term in the United States Senate 1862-3. He wrote a valuable 'History of Rhode Island and Providence Plantations' (2 vols. 1860), and was for many years president of the Rhode Island Historical Society.

Ar'nold, Thomas, an English scholar, head-master of Rugby School, and professor of modern history in the University of Oxford: b. Cowes, Isle of Wight, 13 June 1795; d. 12 June 1842. He received the elements of his education at Warminster, and at the age of 12 was removed to the public school at Winchester. Having obtained a scholarship in Corpus

Christi College, Oxford, he entered that college in his 16th year, and though naturally of a shy disposition soon became remarked for the boldness and independence of his views, and the ability, firmness, and zeal with which he maintained them. In 1815 he was elected Fellow of Oriel College, and both in that year and 1817 obtained the chancellor's prize for Latin and English essays. His views had been early directed to the Church, but some scruples as to signing the articles made him hesitate for a time. At length these scruples gave way before a more careful examination, and he took deacon's orders in 1818. In 1819 he settled at Laleham, near Staines, where he employed himself in preparing young men for the universities, and in 1820 married the sister of one of his earliest school and college friends, Trevenen Penrose. About this time a remarkable change appears to have come over him; his religious views became finally settled, and his whole mind appears to have been wound up to a determination to use life diligently and earnestly for the best and holiest purposes. At Laleham he had much leisure, which he employed partly in the cultivation of general literature, and partly in writing articles on Roman history for the Encyclopædia Metropolitana, and collecting materials for an edition of Thucydides, whose writings, as well as those of Aristotle, had long been his favorites. In 1828, by the unanimous vote of the trustees, who were told on high authority that "he would change the face of education all through the public schools of England," he was appointed head-master of Rugby School, and devoted himself to his new duties with the greatest ardor. While giving due prominence to the classics, he deprived them of their exclusiveness by introducing various other branches into his course, and was particularly careful that the education which he furnished should be in the highest sense moral and Christian. His success was remarkable. Not only did Rugby School become crowded beyond any former precedent, but its pupils on removing to the universities carried off a very large proportion of prizes, and the superiority of Dr. Arnold's system became so generally recognized that it may be justly said to have done much for the general improvement of the public schools of England. In his position as a director of the London University he zealously endeavored to extend the benefits of a literary and scientific education to all classes and creeds without excluding religion; but failing in his efforts to make examination in the Scriptures requisite to obtain a degree, resigned his office. In 1841 he was appointed professor of modern history at Oxford, and delivered his introductory course of lectures with great success. The works by which Dr. Arnold will continue to be best known are his edition of Thucydides, his 'Roman History,' unhappily left unfinished, and his 'Sermons,' most of them prepared for his own chapel at Rugby, and so admirably adapted to the circumstances of the youths who formed the greater part of his audience, that, though written hastily and at broken intervals snatched from other labors, they are justly held to be models in their kind. See Stanley, 'Life and Correspondence of Thos. Arnold' (1860); Worboise, 'Life of Dr. Thos. Arnold' (1859); Fitch, 'Thomas and Matthew Arnold' (1897).

Ar'nold, Thomas, an English writer on literature, and editor of old texts, son of Dr. Arnold, of Rugby, and brother of Matthew Arnold: b. in Laleham, 30 Nov. 1823; d. 1900. He became a Roman Catholic, and spent a number of years in New Zealand and Tasmania. Among his works are 'A Manual of English Literature'; 'Select English Works of Wyclif' (3 vols., 1869); 'Selections from the Spectator'; 'Beowulf' (text, translation, and notes); 'Henry of Huntingdon'; 'Symeon of Durham'; and 'Chronicles of the Abbey of Bury St. Edmunds'; 'Passages in a Wandering Life' (1900). His daughter is the novelist, Mrs. Humphry Ward.

Ar'nold, Thomas Kerchever, an English educator: b. Stamford, 1800; d. 1853. He was educated at Cambridge University, became an Anglican clergyman; and published a large number of text-books for schools, including manuals for the Greek, Latin, French, and German languages.

Arnold of Brescia, är'nold ŏf brĕsh'a (*Arnaldo da Brescia*), an Italian religious and political reformer and agitator: b. about 1100; d. 1155. He was one of the disciples of Abelard, and on returning from Paris began to preach in his native city. In this way he stirred up the people against the clergy; and in France, whither he was forced to flee in 1139, he also found numerous adherents, for the immorality and arrogance of the clergy excited much discontent. The flame which he had kindled could not be extinguished by the excommunication pronounced against him and his adherents by Innocent II. He preached his doctrines in safety at Zürich in Switzerland till about 1144, when he appeared at Rome, where his eloquence occasioned among the people great disorder. The furious multitude, whom he himself could no longer restrain, revered him as their father, and even the Senate protected him till Adrian IV., in 1155, laid an interdict upon the city. This subdued the Romans, and Arnold was obliged to flee. He was taken in Campania, and executed at Rome and his body burned; his ashes were thrown into the Tiber, and his party was suppressed. His followers were known as Arnoldists.

Ar'nold of Winkelried, wĭng'kĕl-rēd, a Swiss hero, who, at the battle of Sempach, in 1386, sacrificed himself to insure victory to his countrymen. The Austrian knights, dismounted, had formed themselves into a phalanx, which the Swiss vainly strove to pierce, when Arnold, rushing on the spear points of the enemy, and burying several in his breast, thus opened a gap in the fence of steel. The Swiss rushed in through the opening, and routed the Austrians with great slaughter.

Ar'noldists. See ARNOLD OF BRESCIA.

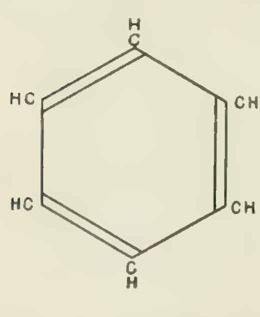
Arnprior, town of Renfrew County, Ontario, Canada; 38 m. by railway W. of Ottawa, on Canada Atlantic and Canadian Pacific Railways; at the confluence of the Madawaska River with the Ottawa. It is an important lumbering centre, and has other milling and manufacturing interests. The country round about is heavily wooded, and the abundance of water-ways especially favors the handling of timber. Pop. (1901) 4,152.

Arok-Szallas, ăr'ōk-säl'äsh, or Jasz-Arok-Szallas, a privileged market-town in Hungary, 44 miles northeast of Budapest. Pop. (1900) 11,190.

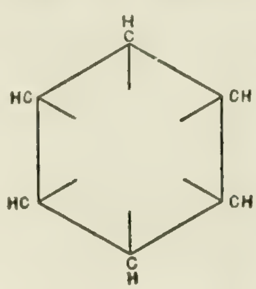
Arolsen, ä'rōl-sĕn, a German town, capital of the principality of Waldeck, on the river Aar. Rauch the sculptor was born here. Pop. (1900) 2,734.

Aro'ma, a Greek term denoting perfume. Many plants yield a more or less delightful odor, often due to volatile oils called essences, which can be separated from them by suitable processes. Sometimes odor proceeds from a substance which cannot be seized, and to which the name of *aroma* is more particularly applied. It appears that substances altogether, or almost altogether, inodorous may be made to diffuse a strong odor by the mixture of different substances which facilitate their volatilization. Thus, when musk is dried, ammonia is separated from it, and seems to be the vehicle of the odor, since the residuum becomes inodorous, and yet may again be made as odoriferous as it was at first by impregnating it with a quantity of the substance which had been carried off. Tobacco, in like manner, owes part of its odor to ammoniacal salts mixed with it in the process of manufacture. One singular fact is that many plants of tolerably strong odor yield an inodorous liquid when dissolved in water and yet communicate odor to the oils with which they are macerated. See Perfumery.

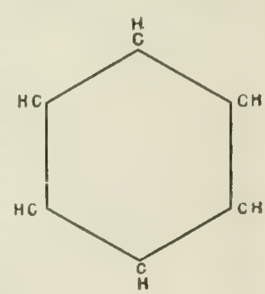
Aromatic Compounds, a numerous and exceedingly important class of substances, fundamentally differing from the fatty compounds in constitution, and named from the fact that the earliest known representatives of the class were resins, oils, and balsams, distinguished by a marked aromatic odor. The name is now applied to all substances containing a "benzene nucleus" (presently to be described). Benzene itself is the simplest example of an aromatic body. Its formula, expressed in the simplest way, is C_6H_6, but when the attempt was made to represent the composition of benzene by a "structural formula," numerous difficulties were encountered. For example, benzene behaves like a saturated compound in most respects, yet it contains eight atoms less of hydrogen than the saturated paraffin "hexane" (C_6H_{14}) containing the same number of carbon atoms. Again, any or all of the hydrogen atoms in benzene can be replaced by other monovalent elements (or radicals); and the persistence of the group C_6 in the derivations of benzene, even when all the original hydrogen atoms have been replaced by other elements or radicals, indicates that the carbon atoms in that body are intimately related to one another, in some manner. Furthermore, it has been proved by experiment that the hydrogen atoms in benzene are "of equal value," so that it makes no difference, in forming a substitution compound, which atom of hydrogen is replaced, and this fact indicates that the hydrogen atoms should occur in the structural formula symmetrically. To reconcile these considerations (and many others) Kekulé, in 1865, proposed for benzene the structural formula preceding.



The symmetry of the body with respect to hydrogen is here evident, and the persistence of the group C_6 is explained by assuming the six carbon atoms to be united to one another in the form of a closed chain, supposed to possess sufficient chemical strength to maintain its own integrity, save under exceptional circumstances. The closed ring of six carbon atoms is the "benzene nucleus," referred to above, which constitutes the distinctive feature of the aromatic compounds as a class. It will be observed that in Kekulé's structural formula the carbon atoms are all tetravalent, just as the carbon is in carbon dioxid (CO_2), and that three of the four valencies of each carbon atom are satisfied by the valencies of other carbon atoms, while the fourth is satisfied, in each case, by a hydrogen atom. Von Baeyer has proposed a slightly different structural formula for benzene, even more symmetrical in appearance than Kekulé's, but which raises certain questions that are not yet answered. His formula is as shown herewith.



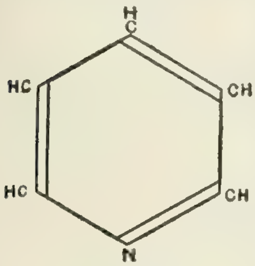
The closed carbon chain is present here also, but only three of the valencies of each carbon atom are definitely provided for, and it is assumed that the six remaining valencies (one to each carbon atom) are satisfied by a sort of "central linkage," whose precise nature is not determined or defined. It is customary, at the present time to express the structural formula of benzene in the simple form without attempting any explanation of the fact that the carbon atoms are here apparently trivalent. Much thought has been expended upon this matter, and the constitution of benzene is one of the most interesting problems in the realm of organic chemistry.



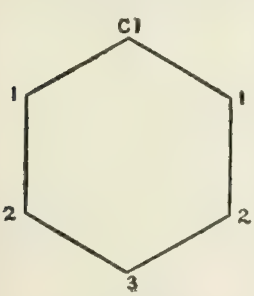
The structural formulas presented above are not to be taken in any sense as pictorial representations of the actual geometrical configuration of the benzene molecule. We know nothing at all about the shape of a molecule, nor about the way in which its parts are associated with one another, in space. The structural formulas employed in chemistry are mere empirical diagrams, for representing, to the eye, the chemical properties and relations that have been observed in the laboratory.

Compounds have been prepared which contain closed rings of three, four, and five atoms of carbon, respectively, but these are not classed as aromatic compounds. They are intermediate,

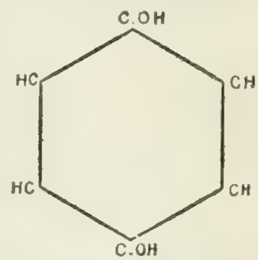
in general properties, between the aromatic series and the fatty series, but resemble the latter more closely. Compounds are also known in which the chain is closed by an atom of oxygen, or of sulphur, or of nitrogen. Thus the structural formula of pyridine is as shown herewith.



Such substances could be classed as "aromatic compounds" by an extension of the definition of the aromatic group, but are usually regarded as outside of the limits of that group. The aromatic compounds are so numerous, and include so many substances of technical importance, that only the merest outline of their general character can be given in this place. In general it may be said that they are derived from benzene by replacing one or more of its typical hydrogen atoms by an equal number of monovalent radicals (either simple or compound). The essential features of these substitutions may be illustrated by considering the chlorobenzenes. By the action of chlorine upon cold benzene, several substitution products are formed, having the formulas C_6H_5Cl, $C_6H_4.Cl_2$, $C_6H_3.Cl_3$, etc., according to the number of atoms of hydrogen that are replaced by the chlorine. The first of these substitution products, $C_6H_5.Cl$, is called simply "chlorobenzene," and it is to be noted that since the hydrogen atoms in the original benzene are all "of equal value" (that is, all involved symmetrically), it makes no difference *which* hydrogen atom is replaced by the chlorine; hence only one chlorobenzene having the formula $C_6H_5.Cl$ is possible. But when a *second* atom of hydrogen is replaced by chlorine, the resulting compound, $C_6H_4.Cl_2$ (known as *di*-chlorobenzene), can exist in no less than three distinct isomeric forms, according to the relative positions of the chlorine atoms in the benzene ring. For let the structural formula of chlorobenzene ($C_6H_5.Cl$) be represented by the skeletonized scheme the numbers representing the several groups of CH, in one of which the hydrogen is to be replaced by a further substitution of chlorine. It is evident that the next chlorine atom may replace a hydrogen atom at any one of the five vertices to which numbers have been attached; but it is also evident from symmetry that the two positions numbered "1" must be considered as essentially identical, so far as the product resulting from a substitution is concerned, and the same is also true of the two positions marked "2." Only three essentially different ways of substituting the second chlorine atom need therefore be considered. When the second chlorine atom is situated at an angle adjacent to the first, the product is known as *ortho*-dichlorobenzene;



when the second chlorine atom is separated from the first by one vortex which still retains its hydrogen, the product is known as *meta*-dichlorobenzene; and, finally, when the two substituted atoms of chlorine are *opposite* one another, the product is known as *para*-dichlorobenzene. The three different dichlorobenzenes thus shown by the structural formula to be possible, are actually known. All aromatic compounds having the general formula $C_6H_4Y_2$ (where Y is a monovalent radical) occur in three isomeric series, just as the chlorobenzenes do, and the separate compounds are distinguished, as already explained in the case of dichlorobenzene, by the prefixes *ortho-*, *meta-*, and *para-*. These prefixes are frequently abbreviated to single letters, in works on chemistry. Thus *p*- dihydroxybenzene is often written in the place of the full name, "para-dihydroxybenzene." This particular substance (used in photography and commonly known as "hydroquinone"), as its name implies, is formed by the substitution of two molecules of hydroxyl (HO) for two atoms of hydrogen in the benzene ring, the hydroxyl molecules being opposite each other (as indicated by the prefix *para-*). Its structural formula, therefore, is as below.



The ortho- compound having the same composition (except that its two hydroxyl molecules are in the "ortho" positions), is a different substance, known more familiarly as catechol, or pyrocatechin, and the meta- compound (where the two molecules of hydroxyl are in the "meta" positions) is quite different from either of the others, and is known as resorcinol. The substitutions of monovalent radicals for the hydrogen atoms in benzene are by no means limited to two, nor need the radicals that are substituted be alike. Thus the pyrogallic acid so extensively used as a developer in photography is obtained from benzene by the substitution of three molecules of hydroxyl for three molecules of the benzene hydrogen; and it therefore has the formula $C_6H_3.(OH)_3$. Vanillin, now largely used in the place of extract of vanilla for flavoring confectionery and ices, is benzene in which three atoms of the original hydrogen have been replaced, respectively, by the groups (CHO), (OCH_3), and (OH). On account of the typographical difficulties involved in printing the structural formulas of the aromatic compounds, chemists often specify the constitution of these compounds by numbering the original hydrogen atoms of the benzene from 1 to 6, and then specifying by number, which hydrogen atom has been replaced by each of the substituted radicals. Thus vanillin (referred to in the previous paragraph) consists of benzene in which CHO has been substituted for the first hydrogen atom, OCH_3 for the third, and OH for the fourth; and with this convention the constitution of vanillin may be expressed thus: $CHO : OCH_3 : OH = 1 : 3 : 4$.

The existence of tertiary (and higher) substitution products of benzene makes it possible to identify the ortho-, meta-, and para- di-substi-

tution compounds, so that the proper designation can be attached to each of them. The di-bromobenzenes afford a good example of the way in which this is accomplished. The three essentially different compounds obtained by substituting bromine for two of the hydrogen atoms in benzene are (according to the notation just given) Br : Br = 1 : 2, Br : Br = 1 : 3, and Br : Br = 1 : 4, these being ortho-dibromobenzene, meta-dibromobenzene and para-dibromobenzene, respectively. Now if an atom of hydrogen in the first of these be replaced by another atom of bromine, it is evident that the new bromine atom may have the position 3, 4, 5, or 6; but the compounds in which the bromine occupies the positions 1 : 2 : 3 and 1 : 2 : 6 must be regarded as identical, as will be seen by constructing the diagram; and, similarly, those in which it occupies the positions 1 : 2 : 4 and 1 : 2 : 5 must be considered identical. Hence the further introduction of bromine into ortho-dibromobenzene can give rise only to the two distinct tri-bromobenzenes 1 : 2 : 3 and 1 : 2 : 4. If the remaining dibromobenzenes be examined in the same way, it will be found that meta-dibromobenzene can yield (upon further bromination) the three distinct tri-bromobenzenes 1 : 2 : 3, 1 : 3 : 4, and 1 : 3 : 5. Finally, it will be found that para-dibromobenzene can yield only one tri-bromobenzene; namely, 1 : 2 : 4. The identification of a di-substitution bromobenzene as ortho-, meta-, or para- is therefore seen to be equivalent to determining how many different tri-bromobenzenes the given di-bromobenzene can yield. This problem has been fully worked out in the case here taken as an illustration, and it has been shown that of the three known di-bromobenzenes, the ortho- compound is the one boiling at 435° F., the meta- compound is the one boiling at 427°F., and the para- compound is the one melting at 180° F. The mode of identification here discussed in detail for bromine substitution products can be applied in other cases also, but the labor involved in the operation is so great that it is usually easier to ascertain the proper prefix for a new di-substitution compound by noting which of the bromo-substitution products must be used as a starting point, in the synthesis of the proposed compound. There is usually but little difference in the boiling points of ortho-, meta-, and para- compounds, but the para- compounds have the highest melting points. The benzene ring of ortho- compounds is liable to be broken up by oxidation, while in the other two classes the ring usually persists. The following general law appears to hold true of di-substitution aromatic compounds: When a radical is introduced into a benzene ring in which one hydrogen atom has already been replaced by a radical, the second radical will take a position "meta" to the first one, provided the first was COOH, SO_3H, NO_2, or (probably) CN, CHO, or $CO.CH_3$. In most other cases the second radical will mainly take the "para" position, though some of the "ortho" compound is almost invariably produced at the same time. The aromatic bodies include many acids, the simpler of which may be conveniently classified according to the number of molecules of carboxyl (COOH) that they contain, and according to the number of hydrogen atoms that have been displaced in the original benzene ring. The simpler and more familiar aromatic acids mostly contain one carboxyl group, and are therefore said to be "mono-carboxylic." In the mono-carboxylic group, benzoic acid, $C_6H_5.COOH$, is "mono-hydric"; salicylic acid, $C_6H_4.OH.COOH$, is "di-hydric"; proto-catechuic acid, $C_6H_3.(OH)_2.COOH$, is "tri-hydric"; and gallic acid, $C_6H_2.(OH)_3.COOH$, is "tetra-hydric." Numerous substances classed by the chemist as alcohols also occur in the aromatic group. The simplest of these (and the only one containing only six atoms of carbon) is phenyl alcohol, which is also known as phenol, and as carbolic acid. This substance is formed when benzene is oxidized by peroxid of hydrogen, in accordance with the equation.

C_6H_6	+ H_2O_2	=	$C_6H_5.OH$	+ H_2O.
Benzene.	Hydrogen peroxid.		Phenyl alcohol.	Water

Phenol is called an alcohol on account of its chemical structure (see ALCOHOL), but it differs widely from the alcohols of the fatty series, since it does not yield an aldehyde, an acid nor a ketone, and it is not easily oxidized. Other aromatic alcohols may be prepared by replacing a hydrogen atom in benzene by one of the alcohol radicals (C_nH_{2n+1}) of the fatty series, and then substituting an OH group for one of the hydrogen atoms in the compound so formed. The resulting substance has widely different properties, according to the position of the OH group so introduced. If the OH replaces a hydrogen atom in the alcohol radical, the final compound is called an alcohol; but if it replaces a hydrogen atom in the original benzene ring, the final compound is more accurately classed as a phenol. For example, if CH_3 be substituted for an atom of hydrogen in benzene, toluene ($C_6H_5.CH_3$) is formed. If, now, OH is substituted for a hydrogen atom in the CH_3, the resulting substance, $C_6H_5.CH_2OH$, is known as benzyl alcohol; while if the OH is substituted for an H in the original ring, we have $C_6H_4.(OH).CH_3$, a substance known as cresol, and more properly described as a phenol than as an alcohol. One of the most important members of the aromatic group is amido-benzene, or aniline (q.v.).

A. D. RISTEEN, PH.D.,
Editorial Staff, 'Encyclopedia Americana.'

Ar'omat'ics, plants (sometimes animal and other substances) which have a spicy odor and pungent taste and are used in medicine, cookery, and perfumery. They are largely employed to disguise the taste of drugs, are usually reputed stimulant, antispasmodic, and, if bitter, tonic and vermifuge; externally they are applied as antiseptics, local anæsthetics and counter-irritants. Their active principles are volatile oils obtained by distillation; but some contain camphor-like substances, such as turpentine; others are bitter like tansy; still others contain an odorous resin, for example, myrrh and benzoin; and lastly there are those with a musky odor, such as the musk plant (q.v.). Among aromatics and the families to which they belong are: peppermint, thyme, lavender, of the *Labiatæ* — the whole plant, especially the leaves; caraway, dill, anise, of the *Umbelliferæ* — the seeds or seed capsules; ginger, *Zingiberaceæ*—the root-stocks; cinnamon, cassia, of the *Lauraceæ Myrtaceæ* — the bark; cloves, *Myrtaceæ* — the flower buds; and vanilla, of the *Orchidaceæ* — the fruits.

Ar'omat'ic Vinegar, a liquid consisting of strong acetic acid, and obtained by distilling crystallized diacetate of copper. Its aroma is due to the presence of *acetone,* but it is also usually highly flavored with preparations, such as cloves, calamus, etc. It has a pleasant perfume, and its vapor, when inhaled, has a powerful effect on the nostrils, and acts as a strong excitant on the whole system. The liquid is highly corrosive.

Arona, ä-rō'nä, Italy, an ancient town near the southern extremity of Lago Maggiore. In the vicinity is the colossal statue of San Carlo Borromeo, 70 feet high, exclusive of the pedestal, 42 feet high. There are silk, cotton, and metal works here. Pop. (1901) 4,700.

Aroo. See ARRU ISLANDS.

Aroostook, a-roos'tŭk, a river in Maine. It rises in Piscataquis County, Me.; flows more than 120 miles in a circuitous course, and enters the St. John River in New Brunswick. It was an important factor in the settlement of the long-pending dispute concerning the boundary between the United States and British America.

Aroostook, Lady of The, the title of a book written by W. D. Howells in 1879 — one of the author's early works. The Aroostook is a trading vessel, and the lady of the story is the sole woman passenger in a voyage across the Atlantic. The story is strong and interesting, and contributed greatly to the early reputation of Mr. Howells.

Arouet, a'roo-ā'. See VOLTAIRE.

Around the World in Eighty Days, a noted romance by Jules Verne. Phineas Fogg, an English gentleman, wagers that a man can travel around the world in 80 days. He wins his wager, after a series of exciting adventures.

Around-the-World Records. Many years have elapsed since Mr. Phineas Fogg, M. Jules Verne's mythical hero, accomplished the supposedly impossible task of circumnavigating the globe in 80 days, a feat which won for him a wager of $100,000, and incidentally, a wife. Since that time, however, so many improvements have been made in methods of transportation, so many new routes — like that of the Trans-Siberian Railway (q.v.) — have been completed that Mr. Fogg's once remarkable trip now appears in the light of an extremely commonplace achievement. In fact the person who, to-day, could not travel around the world in less than 80 days would be regarded as a very inexperienced globe-trotter. The first serious attempt to lower Jules Verne's imaginary record was made in 1890, when Miss Nellie Bly, who represented the *New York World,* made the trip around the world against time. She was followed by the late George Francis Train, and both succeeded in accomplishing the tour in less than 70 days. Ten years later Mr. George Griffith, of Chiswick, England, established a new record at 64½ days, but this record stood for less than a year, it having been reduced, in 1901, to 60 days and 13½ hours, by Charles C. Fitzmorris, who made the trip at the request of Hearst's *Chicago American.* The success of Fitzmorris was the means of inspiring many persons to participate in this unique form of record breaking, among the contestants there being several journalists, the representatives of European and Canadian papers. All attempts to lower this last record were unsuccessful, however, until December 1903, when Mr. James Willis Sayre of Seattle, Wash., earned the honors for record breaking by girdling the globe in 54 days, 9 hours and 42 minutes, an achievement that lowered the Fitzmorris record by more than 6 days and 3 hours. Mr. Sayre's itinerary was as follows: From Seattle to Yokohama, Japan; thence by rail to Kobe, Moji, and Nagasaki, Japan; then by steamer to Dalny, Manchuria, and so on to Liverpool by what was practically an all-rail journey of 7,600 miles. At Liverpool he boarded a steamer for New York, and, two hours after his arrival in America, he was on a train bound west, for Seattle. This feat of lowering the world's record for globe-girdling was accomplished without the use of special trains, or boats, or any other method of travel beyond the means of the ordinary tourist.

Arpad, är'päd, the conqueror of Hungary, and founder of the Arpad dynasty, which reigned till 1301. He was born in the second half of the 9th century; died in 907. He was the son of Almus, whom the seven Magyar clans dwelling in the steppes northeast of the Caspian Sea had elected their hereditary chief about 889. Thus united into one nation, the Magyars, mustering about 25,000 warriors, crossed the Carpathians and conquered Hungary, when Arpad was elected their prince.

Arpeggio, är-pĕj'ō (Italian, from *Arpa,* a harp), in music, the playing of a chord on a keyed or stringed instrument by sounding the notes, not together, but in rapid succession.

Arpino, är-pē'nō (ancient *Arpinum*), a town of southern Italy, celebrated as the birthplace of Caius Marius and Cicero. It is situated on a rising ground near the river Garigliano, was originally founded by the Volsci, and became a municipal town under the Romans. It is still a place of some importance, possesses a royal college and several churches, and manufactures woolens. Pop. (1900) 10,607.

Arquebus, är'kwe-bŭs, an ancient species of firearm resembling a musket. It was fired from a forked rest, and sometimes cocked by a wheel, and carried a ball that weighed nearly two ounces. A larger kind used in fortresses carried a heavier shot. See ORDNANCE.

Arracacha, ăr'ra-kä'cha, or **Aracacha,** a genus of umbelliferous plants of Southern and Central America. The root of *A. esculenta* is divided into several lobes, each of which is about the size of a large carrot. These are boiled like potatoes and largely eaten in South America.

Ar'rack, or **Rack,** a name applied by Orientals to a strong spirituous liquor distilled from rice, from the juice of the cocoanut, date, and other palms, or from molasses. The arrack of Goa and Colombo in Ceylon is distilled from palm-juice alone, after being allowed to ferment; that of Batavia and Jamaica from rice and molasses. The rice is turned into malt by being soaked in water and allowed to sprout, after which the arrack is distilled from it on fermentation taking place in the same way as whiskey from barley-malt. The rice is also often used without being malted. The distillation of the fermented liquor affords the third or worst sort of arrack; this mixed with a little water and

again distilled gives the second best sort; a third distillation produces the best sort, which is seldom exported. The arrack sold in Europe is seldom genuine. Pure arrack is clear and transparent, with a yellowish or straw color, and a peculiar but agreeable taste and smell; it contains at least 52 to 54 per cent of alcohol. Not much of it is imported into England, but it is largely drunk in India and the East generally, the Indian and Pacific Islands, Africa, and South America. The arrack of Japan is known as saki.

Arragonite, a common but erroneous spelling for the mineral Aragonite (q.v.).

Ar'rah, a town of British India, in Bengal. The surrounding country is fertile and well cultivated, and near the town is a large and beautiful lake. It was rendered famous during the mutiny of 1857 by the heroic resistance of a body of 20 civilians and 50 Sikhs, cooped up within a detached house, to a force of 3,000 sepoys, who were ultimately routed and overthrown by the arrival of a small European reinforcement. Pop. 47,000.

Arrah Na Pogue, är-ra nä pōg, a play by Dion Boucicault. (q.v.).

Arraign'ment, in the practice of criminal law the calling of a prisoner by his name to the bar of the court to answer the matter charged upon him in the indictment. His innocence being presumed, it is the law, and is so laid down in the most ancient books, that, though charged upon an indictment of the gravest nature, he is entitled to stand at the bar in the character of a free man, without irons or any manner of shackles or bonds, unless there be evident danger of his escape, or of violence at his hands.

Arran, ăr'ăn, an island of Scotland, in the Firth of Clyde, 20 miles long, and 10 miles wide, with an area of 165 square miles. The island attains its loftiest summit in Goatfell, which is 2,900 feet high. The southern portion is rather hilly than mountainous, and contains several arable tracts of considerable extent and tolerable fertility. The geology of Arran has attracted much attention, as furnishing within a comparatively narrow space distinct sections of the great geological formations. The botany possesses almost equal interest, both in the variety and the rarity of many of its plants. Among objects of historical interest are the cave of Drumidoon, relics of Danish forts, and Druidical stones. Pop. (1900) 6,000. Consult 'A May Week in Arran' (1882).

Arras, är'ras', a town of France, capital of the department of Pas-de-Calais, in the middle of an extensive and fertile plain, on the Scarpe, which here becomes navigable. It is a well-built town, and has several handsome squares and a citadel, but is no longer fortified. The chief public buildings are the modern cathedral, the extensive buildings of the former abbey of St. Vaast, now accommodating a museum and the public library of 50,000 volumes; the Hôtel de Ville, one of the handsomest in the north of France, with a fine Gothic façade; the theatre, Hôtel de la Prefecture, barracks, etc. Its industries are varied and important. In the Middle Ages it was famous for the manufacture of tapestry, to which the English applied the name of the town itself. The corn-market of Arras is the most important in the north of France. It was the birth-place of Robespierre. Pop. (1900) 26,000.

Arrate y Acosta, är-rä'tā e a-kōs'ta, a Cuban historian: b. Havana, 1697; d. 1766. His history of Cuba entitled 'Llave del Nucoo Mundo y ante mural de las India Occidentales' remained in manuscript until 1830.

Arrawak, är'ra-wak. See ARAWAK.

Arrebo, är'rē-bō, **Anders Christensen,** a Danish poet: b. Aroöskjobing, 1587; d. 1637. He was made Bishop of Drontheim, Norway, when only 31, but deposed in 1622, owing to his objectionable life; he was afterward rehabilitated as preacher in Vordingborg. As the pioneer of the Renaissance movement, he is considered the father of modern poetry in Denmark. His rhymed translation of the 'Psalms of David' (1623), but especially his 'Hexameron' (1641), an imitation of a once famous poem of the French poet Du Bartas on the 'Creation,' are highly esteemed.

Arrest', the seizure of a suspected criminal or delinquent that security may be taken for his appearance at the proper time before a court to answer to a charge. Ordinarily, a person can be arrested only by a warrant from a justice of the peace; but there are exceptional cases in which he can be apprehended by an officer without a warrant, by a private person also without a warrant, or by what is technically called a "hue and cry."

Any peace officer, as a justice of the peace, sheriff, coroner, or watchman may, without a warrant, arrest any one committing a felony in his presence, 3 Hawkins Pl. Cr. 164; Tiner *v.* State, 44 Tex. 128; Reg. *v.* Chapman, 12 Cox. C. C. 4, or committing a breach of the peace, during its continuance, 3 Wend. N. Y. 384, or even to prevent the commission of a breach of the peace, Rex. *v.* Herns, 7 C. & P. 312, 32 E. C. L. 522, and such officer may arrest anyone whom he reasonably suspects of having committed a felony, whether a felony has actually been committed or not. 40 N. Y. 463; 25 Abb. N. C. 298; 3 Park. Cr. N. Y. 249; 99 Pa. St. 63.

A private person who is present when a felony is committed, 3 Wend. N. Y. 353; 1 Mood. 93; or during the commission of a breach of the peace, 10 Cl. & Fin. Hon. L. 28; 25 Vt. 261, may and should arrest the felon, and may upon reasonable suspicion that the person arrested is the felon, if a felony has been committed. 3 Wend. N. Y. 353; 6 Term 315.

An arrest is made by touching the body of the person accused. The object of arrest being to make sure that he answers to a charge about to be brought against him, it does not follow that after being seized he is incarcerated: if bail for his appearance at the proper time be given, and the case be not too aggravated a one for such security to be accepted, he will be released till the day of trial.

Arrest of Judgment, in law, is the act or process of preventing a judgment or verdict from being carried out till it shall be ascertained whether it is faulty or legally correct. Judgment may be arrested (1) when the declaration made varies from the original writ; (2) where the verdict materially differs from the pleadings and issue thereon; and (3) where the case laid in the declaration is not sufficient in law to admit of an action being founded upon it. A mo-

tion for arrest of judgment must be grounded on some objection arising on the face of the record itself. People *v.* Thompson, 41 N. Y. 1; People *v.* Kelley, 94 N. Y. 526. If the judgment is arrested all the proceedings are set aside, and judgment of acquittal is given, but this will be no bar to a new indictment.

Ar'rhenathe'rum, a genus of three species of tall perennial grasses closely allied to the oat (q.v.). *A. elatius* or *avenaceum* (also known as *Avena elatius* and *Holcus avenaceus*), which, as these names imply, bears a resemblance to oats, and sometimes called oat grass and French rye grass, is widely cultivated for fodder in France. True rye grass (*Lolium*) is, however, not a close relative.

Arrhenius, är-rā'nĭ-ŭs, **Svante,** a noted Swedish chemist: b. in Upsala in 1850. He was educated at the University of Upsala and after making many original investigations became professor in the University of Stockholm in 1891. His researches have been of the highest importance, the establishment of the theory of electrolytic dissociation being due to him. This theory supplies a reasonable explanation of many chemical phenomena otherwise insoluble and correlates various facts between which no connection has been previously discovered. He has published 'Sur la conductibilité galvanique des électrolytes' (1884), and a treatise in German on electro-chemistry (1902).

Ar'ria, a celebrated Roman matron, wife of Cæcinna Pætus, consul during the reign of Claudius, about 41 A.D. Pætus having raised an unsuccessful revolt against Claudius, in Illyria, was condemned to die, but was allowed the option of ending his life by suicide, which the Romans did not deem a crime. Pætus hesitated; Arria seized the dagger, plunged it into her bosom, and then presenting it to her husband, said, "It is not painful, Pætus."

Arriaga, är're-ä'ga, **Pablo José d',** a Spanish Jesuit: b. 1562; d. 1622. He was the first rector of the Jesuit College in Lima and wrote a valuable history entitled 'Estirpacion de la Idolatria de los Indos del Peni.'

Ar'ria'nus, a celebrated Greek historian, a native of Nicomedia, in Bithynia, who flourished in the 2d century under the Emperor Hadrian and the Antonines. He was a disciple of Epictetus, whose lectures he edited. While residing in Greece he gained the friendship of the Emperor Hadrian, who bestowed upon him the citizenship of Rome (124 A.D.), and subsequently appointed him prefect of Cappadocia. In this capacity he distinguished himself in the war against the Massagetæ. He was afterward advanced to the senatorial and even consular dignities. Like Xenophon, whom he imitated in style, he united the literary with the military character. His writings were numerous, but many of them have perished. His 'Anabasis' of Alexander the Great, still extant, narrates the Asiatic expedition of Alexander, and being based on the memoirs of Ptolemy Lagus and Aristobulus, who both served under that king, is proportionably valuable. To this is added a book on the affairs of India, which pursues the history of Alexander, but is not deemed of equal authority. An epistle from Arrianus to Hadrian is also extant, entitled 'Periplus Ponti Euxini' (A Voyage around the Euxine or Black Sea). There are also ascribed to him 'Treatise on Tactics'; and a 'Periplus of the Sea of Azof' and of the Red Sea, of which the authority is doubtful. We possess also his 'Enchiridion,' a moral treatise containing an abstract of the practical philosophy of Epictetus. There have been various editions of the 'Enchiridion' and the 'Anabasis.' His philosophical works have been translated by T. W. Higginson (Boston 1891) and the 'Anabasis' by Chinnock (1893).

Arrondissement, ä'rôṅ-des-mäṅ, a name given in France to the subdivision of a department, or of the quarters of some of the larger cities, as in Paris. The arrondissement is under the government of a Sub-Prefect.

Arroo. See ARRU.

Ar'row, a missile weapon, straight, slender, pointed, and barbed, to be shot with a bow. See ARCHERY.

Arrowhead, *Sagittaria,* a genus of plants of the natural order *Alismaceæ,* distinguished by unisexual flowers, having three herbaceous sepals and three colored petals, numerous stamens, and numerous carpels, which are compressed, one-seeded, and on a globose receptacle. They are aquatic plants, natives of very different climates, from the tropics to the cold regions of the world. The common arrowhead (*S. sagittifolia*) is a beautiful plant, a native of England, with arrow-shaped leaves which rise above the surface of the water. It is one of those plants which have enjoyed an undeserved reputation as cures for hydrophobia. The corms (or solid bulbs), dried and powdered, have sometimes been used for food, but have an acrid unpleasant taste. The Chinese arrowhead (*S. sinensis*) is a native of China, and has long been cultivated in that country and Japan for its eatable corms, which, in a fresh state, are somewhat acrid, but abound in starch. It has arrow-shaped acute leaves, and a branched polygonal scape (leafless stem). It is grown in ditches and ponds. It is one of the plants sometimes cultivated in tanks in hothouses.

Ar'row Lake, the name given to an expansion of the Columbia River, in British Columbia, about 95 miles long from north to south. It is often regarded as forming two lakes — the Upper and Lower Arrow.

Ar'row-root, a fine grained starch esteemed for making desserts and invalid foods. It is extracted from the underground parts of various tropical plants, especially of the genus *Maranta* of the natural order *Marantaceæ.* The popular name is said to be derived from the practice of the South American Indians who used the freshly dug rootstocks as an antidote for poisoned arrow-wounds. Probably, however, the derivation is from the Indian word *ara.* The principal species is *Maranta arundinacea,* indigenous to tropical America and cultivated in the West Indies, India and other warm countries. It is a perennial plant about two feet high, has small white flowers and fruits about the size and form of currants. The rootstocks, which often exceed a foot in length and three quarters of an inch in diameter, are yellowish white, jointed and covered with loose scales which must be carefully removed before the extraction of the starch, because they impart their disagreeable flavor if allowed to remain. The process of extraction, which is simple but usually crudely practised, is as follows: The root-

stocks are dug when a year old, well washed, peeled, beaten to a milky pulp in deep wooden mortars, and well washed to remove the fibrous parts, which are thrown away. The crude starch is next passed through a sieve or a coarse cloth and allowed to stand until the starch has settled, when the water is drawn and the white residue again washed. After again settling, the water is drawn off and the pulp when dried in the sun is reduced to powder. On a large scale arrow-root is manufactured with the aid of specially constructed machinery, but the process is essentially as described. Bermudian arrow-root is considered the best in the market, and next to it is that of Jamaica. The East Indian product is believed to be inferior, perhaps because of adulteration with or substitution of other starches, practices induced by the great demand and the high prices paid for the genuine. Some of these other starches are obtained from closely related plants, among which may be mentioned certain species of the genera Canna (q.v.), Curcuma (see TURMERIC), Manioc (see CASSAVA), Tacca (q.v.) and Arum. Potato, corn, rice and wheat starch and fine sago are also sold for arrow-root, but may be identified by miscroscopical examination; the form and markings of the starch grains differ from those of the arrow-root granules. When dry, arrow-root is odorless, but when damp has a slight smell. Like other carbohydrate foods, it is a source of energy, but since it is deficient in nitrogen compounds it should be mixed with eggs, milk, or other substances rich in nitrogenous materials, to form a well-balanced diet.

The amount of fecula or starch present in the roots of the *Maranta* varies according to age, and runs from 8 per cent, in those of the young plants, to 26 per cent when full grown. The latter stage is reached when the plant is 10 to 12 months old; and the roots then present the following composition in 100 parts.

Starch, fecula, or arrow-root	26
Woody fibre	6
Albumen	1½
Gummy extract, volatile oil, and salts	1
Water	65½

Arrow-root is exported in tin cases, barrels, or boxes, carefully closed up. It is a light, opaque, white powder, which, when rubbed between the fingers, produces a slight crackling noise, like that heard when newly fallen snow is being made into a snowball. Through the microscope, the particles are seen to be convex, more or less elliptical, sometimes obscurely triangular, and not very different in size. The dry farina is quite inodorous, but when dissolved in boiling water it has a slight peculiar smell, and swells up into a very perfect jelly. Potato starch, with which it is often adulterated, may be distinguished by the greater size of its particles, their coarser and more distinct rings, and their more glistening appearance. Refined sago-flour is used for adulteration, many of the particles of which have a truncated extremity, and their surface is irregular or tuberculated. Arrow-root is also sometimes adulterated with rice-starch and with the common starch of wheat-flour.

The starch of the cassava, manihot or manioc is sometimes imported into Europe under the name of Brazilian arrow-root. Potato-starch, carefully prepared, is sometimes sold as English arrow-root; and the farina obtained from the roots of the *Arum maculatum*, as Portland arrow-root. Otaheite arrow-root is the starch of *Tacca pinnatifida*. All these, as well as Oswego and Chicago corn-flour — the starch of maize or Indian corn — are so nearly allied to true arrow-root as not to be certainly distinguishable by chemical test; but the forms of the granules differ, so that they can be distinguished by the microscope.

Ar'rowsmith, Aaron, an English cartographer: b. Winston, 1750; d. 1823. He raised the execution of maps to a perfection it had never before attained. His nephew, John, b. 1790, d. 1873, was no less distinguished in the same field; his 'London Atlas of Universal Geography' may be especially mentioned.

Arroyo, är-rō'yō, the name of two towns of Spain, in Estremadura. Arroyo del Puerco, about 10 miles west of Caceres, has a palace of the old dukes of Benevente, and a parish church adorned with some paintings by Morales. Arroyo Molines de Montanches, about 27 miles southeast of Caceres, is noted as the scene of the defeat of the French, 28 Oct. 1811, by the British under Lord Hill.

Arru (a-roo') **Islands,** a group belonging to the Dutch, situated to the south of western New Guinea, and extending from north to south about 127 miles. They consist of one large island and a number of smaller. They are all low and swampy, but well wooded and tolerably fertile. The natives belong to the Papuan race, and many of them have been converted to Christianity by Dutch missionaries. The chief exports are trepang, tortoise-shell, pearls, mother-of-pearl, and edible birds'-nests, which they exchange for European goods. Agriculture is in a primitive state, but maize, sugar-cane, beans, bananas, etc., are cultivated. Sago is the chief diet, little animal food being eaten. Pop. about 15,000.

Arsaces, är-sā-sēz, founder of a dynasty of Parthian kings, who, taking their name from him, are called Arsacidæ.

Arsamas, är'sā-măs, a manufacturing town in the Russian government of Nijni-Novgorod, situated on the right bank of the Tiesha, 250 miles east of Moscow. It contains 34 churches, several convents and schools, 19 tanneries, several soap-works, linen factories, etc., and has a considerable trade. Pop. (1901) 12,380.

Ar'senal, a magazine, or place appointed for the making, repairing, keeping, and issuing of ordnance and other appliances required in warfare, whether in the army or navy. Sometimes the name is applied to an establishment where such articles are kept in store only, but the chief arsenals also embrace large factories or workshops. The principal arsenals of the United States are those in Allegheny, Pa.; Augusta, Ga.; Benecia, Cal.; Columbia, Tenn.; Fort Monroe, Va.; Frankford, Pa.; Indianapolis, Ind.; Kennebec, Me.; New York, N. Y.; Rock Island, Ill.; San Antonio, Tex.; Watertown, Mass.; and Watervliet, N. Y. There are also powder depots at St. Louis, Mo., and Dover, N. J.; a noted armory at Springfield, Mass., an ordnance proving ground at Sandy Hook, N. J. The Royal Arsenal, Woolwich, England, which manufactures warlike implements and stores for the army and navy, was formed about 1720. In France, each territorial military district (19 in all, including Algeria) has its own special arse-

nal or its own depot of war material. There are naval arsenals at the great government dockyards, namely Cherbourg, Brest, Lorient, Rochefort, and Toulon. The chief arsenals of Germany are situated at Spandau, Cologne, and Dantzig, that at the first-mentioned place being the great centre of the military manufactories. The chief Austrian arsenal is the immense establishment at Vienna, which includes gun-factory, laboratory, small-arms and carriage factories, etc. Austria also purchases quantities of her military stores from private manufacturers. Russia has her principal arsenal at St. Petersburg with supplementary arsenals elsewhere. In Italy, Turin is the centre of the military factories.

Ar'senic, an elementary substance, resembling the metals in its physical properties, and formerly classed with them. In its chemical relations, however, it is decidedly non-metallic, and at present the books mostly place it among the non-metals, though it is still customary to speak of the element itself as «metallic arsenic,» to distinguish it from the «white arsenic» of commerce, which is, properly speaking, an oxide of arsenic. Compounds of this element have been known for many centuries, chiefly on account of their poisonous character. The yellow sulphide of arsenic, otherwise called «orpiment,» was known to Dioscorides, who called it *arsenikon,* probably on account of its powerful properties; the Greek word *arsen,* from which it is derived, signifying «male.» Arsenic occurs in the metallic form in nature, usually with ores of iron, silver, cobalt, nickel, and antimony. Large masses of it are found at Zimeoff, in Siberia, and it occurs also in Saxony, Alsace, Bohemia, Transylvania, in the Harz, in Chile, in Japan, at Kongsberg in Norway and in parts of the United States. Combined with other substances, it is one of the most widely distributed of the elements, although the total amount of it in the world does not appear to be large. It occurs in various kinds of pyrites, and is therefore a common impurity in sulphuric acid (much of which is made from pyrites), and in substances in the manufacture of which this acid is used. The minerals known as kupfernickel (niccolite), realgar, orpiment, mispickel (arsenopyrite), and nickelglance (gersdorffite) contain it, as well as many others. The appearance of metallic arsenic varies greatly with the source from which it is obtained, and the method adopted for preparing it. That obtained from pyrites is usually compact, crystalline, and nearly white, while that obtained from arsenious acid is gray and pulverulent. The element is usually described as a «steel-gray metalline mass,» which, at ordinary temperatures, has neither odor nor taste. One chemist (Ludwig) obtained arsenic with «a perfectly bright surface, resembling freshly granulated zinc»; but it is doubtful if this was the pure element, since in preparing it he mixed with it a small quantity of iodine. For commercial purposes, metallic arsenic is obtained by refining the element as it occurs in nature, or by extracting it from arsenopyrite. The process of extraction from arsenopyrite consists in heating that mineral in earthenware retorts or tubes. arranged horizontally in a long furnace, and each having a piece of thin sheet-iron rolled up and inserted into its mouth. On distilling, most of the arsenic condenses on the sheet-iron, from which, after cooling, it may be detached. The product so obtained is further purified by mixing it with pulverized charcoal and re-distilling. The earthenware retorts that are used in the process are made with great care. They are composed of one part of fresh clay and two parts of pulverized bricks or old retorts, and are coated with a mixture of blood, loam, forge scales, and alum, which produces a glaze through which the poisonous vapors of the arsenic cannot penetrate. They are then fired. Arsenic is brittle and crystalline, and its hardness, on the mineralogical scale, is about 3.5. Its specific gravity ranges from 5.2 to 5.7, although a certain variety of it (according to Bettendorff) has a specific gravity as low as 4.71. It has several allotropic forms, one of which is crystalline, and the other black and amorphous. The specific heat of the crystalline variety is 0.083, and that of the amorphous variety is 0.076. Arsenic conducts electricity better than mercury does; for if the specific resistance of mercury at 32° F. be taken as unity, the specific resistance of arsenic is 0.373 at 32° F., and 0.534 at 212° F. The chemical symbol of arsenic is As, and its atomic weight is about 74.44 (Clarke). Its co-efficient of expansion is .000 00311 per degree F. Arsenic oxidizes slowly when exposed to the air, forming a gray powder which is sometimes sold under the name of «fly-powder.» It is not affected by pure water. When heated in the air it burns with a blue flame, giving off a characteristic, highly disagreeable, garlic-like odor. When protected from the air, metallic arsenic volatilizes at a red heat, without melting; its vapor being a light citron yellow, and phosphorescent. When heated under heavy pressure, arsenic melts at about 900° F.

Metallic arsenic forms alloys with many metals, some of which are produced by pulverizing and intimately mixing the constituents, and subjecting them to a pressure of 6,000 or 7,000 atmospheres. If much arsenic be present, the alloys are usually brittle. Arsenic is an undesirable impurity in iron, in general, but it is sometimes added to iron and steel for the manufacture of small chains and ornaments, because it makes the metal susceptible of a very brilliant polish. When alloyed with copper, arsenic gives a brittle gray metal, having a brilliant, silvery appearance, which is used somewhat for making buttons. The chief use of metallic arsenic, however, is in the manufacture of small shot. Pure melted lead, when dropped from a height, tends to form tailed drops; but if arsenic be added in small quantities this tendency disappears, and the drops are much rounder. With hydrogen, arsenic forms a very important gaseous compound known as arseniuretted hydrogen, or arsine, and having the formula AsH_3. This compound is best obtained by the action of sulphuric acid upon an alloy of arsenic and zinc. It is colorless, and so poisonous that Gehlen, its discoverer, was killed by inhaling a single bubble of it. Arseniuretted hydrogen burns with a bluish flame, and metallic arsenic is deposited upon a cold body that is held in the flame. Marsh's test for arsenic depends upon this fact. In executing this test, zinc and sulphuric acid are added to the solution to be tested, and the hydrogen evolved

is allowed to issue from a small jet, where it is lighted. A piece of cold white porcelain is then held in the flame, and if arsenic be present, the characteristic dark, metallic, mirror-like deposit will be produced, owing to the arseniuretted hydrogen that is evolved, simultaneously with the hydrogen. Antimony gives the same kind of a deposit, so that it is important to examine the deposit (or "arsenical mirror," as it is technically called,) to make sure that it is not composed of antimony. Marsh's test is extremely delicate, and will demonstrate the presence of incredibly small traces of arsenic, if proper precautions are taken to ensure absolute purity in the zinc and sulphuric acid that are used. Scheele's green (known chemically as "arsenite of copper") is a compound of copper, arsenic, oxygen, and hydrogen, of a light green color. It was formerly much used in calico printing and for wall paper. Schweinfurth green is a different compound of the same elements, and is used for similar purposes. A great diversity of opinion has prevailed among chemists as to the danger of using arsenical colors, especially in connection with wall papers. Some maintain that "there is no possibility of any arsenical exhalation arising from the walls, as has been alleged"; while others claim that certain microscopic fungi and other low forms of vegetable life act upon these coloring matters, and cause the elimination of arseniuretted hydrogen, which can actually be detected in the air of rooms hung with arsenical papers. Schweinfurth green is better known in the United States by the name "paris green," and is much used for preventing the destruction of crops by insects.

The most familiar compound of arsenic (with the possible exception of paris green) is undoubtedly arsenious oxide, As_4O_6 (often written As_2O_3), or "white arsenic," known to the general public simply as "arsenic." This is used extensively in the arts, in the manufacture of indigo blue and anilin; in glass-making, to remove the color due to the lower oxides of iron; in fly and rat poisons; in taxidermy; and for many other purposes. It is very poisonous, and in the 16th and 17th centuries was commonly used for removing persons who were conceived (by their enemies) to have outlived their usefulness. Nearly all the great poisoners of that period were women. In 1659 a secret society of young wives was discovered in Rome, whose chief object was to make away with the husbands of the members by the use of arsenical preparations. Hieronyma Spara, the woman who provided the members with the poison and instructed them in its use, was eventually executed, together with 12 others. An even more notorious case was that of the woman Tophania, who lived at Palermo and at Naples, and prepared, for wives who desired to be freed from their husbands, a poison known as *aqua Tophania.* This "aqua" purported to be an oil that oozed from the tomb of St. Nicholas of Barri; but as a matter of fact was an arsenical solution. "White arsenic" is not very soluble in water, and as four drops of Tophania's preparation were reputed to constitute a fatal dose, it is not unlikely that it consisted essentially of potassium arsenite, K_3AsO_3, a substance which is formed when "white arsenic" is dissolved in a solution of potash. Tophania plied her nefarious business from girlhood to the age of 70, but her crimes were ultimately brought home to her, and she was tortured and put to death. Detection almost certainly awaits the poisoner of to-day who uses arsenic, and a career such as Tophania's is absolutely impossible.

Ar'sen'ical Poisoning. Arsenic is now used in so many ways that accidental poisoning occurs very often. As a poison employed in committing suicide, and for slow poisoning with homicidal intent, its popularity is on the wane. The forms of poisoning mostly seen are of the chronic type. These occur from the use of paints containing large quantities of Scheel's green or Paris green; from the use of spraying solutions, now so widely employed as a means of protection from insect and fungus pests, and from the addition of arsenic to food stuffs, as a preservative. Acute forms of poisoning are more often the result of attempts to commit suicide. In acute arsenical poisoning the early symptoms are those of an acute inflammation of the stomach and intestines, coming on about half an hour after taking the poison. There are violent cramp-like pains, with nausea, vomiting, and diarrhœa, closely following the premonitory symptoms of distress, difficulty in swallowing, and constriction in the throat. The severe symptoms multiply, the diarrhœa becomes watery, "rice water" and blood may appear in the vomit. A cold, damp skin, weak and feeble heart-action, collapse and sighing respiration may precede death, attended at times with convulsions. Death may occur within 24 hours, but it is apt to be delayed from two to four days, the patient usually dying of the secondary degenerations in the organs and of exhaustion. Death by arsenic is very painful. It is, moreover, an extremely uncertain poison, because of its insolubility, and of the vomiting reaction it induces. Many acute cases pass over into the chronic stage of poisoning.

Chronic arsenical poisoning may result from a single large dose, but more often results from the long-continued use of small quantities of the poison. In a recent outbreak of chronic arsenical poisoning in Manchester, hundreds of people were affected. The source of the poisoning was from arsenic in iron pyrites employed in making sulphuric acid; this certain sulphuric acid had been utilized in the manufacture of glucose. Several firms had purchased this glucose for the manufacture of beer, and many hundreds of the consumers of this beer suffered from various forms of arsenical poisoning. Chronic arsenical poisoning may result from the use of wall-papers and hangings colored by arsenical dyes, although such modes of poisoning may be considered extremely rare. The symptoms of this type of poisoning are of gradual onset: the patient is languid, weak, and loses his appetite. There is discomfort in his intestines and diarrhœa or constipation may result. A sub-acute inflammation of the mucous membrane of the nose and gums then develops, with sore gums, puffiness under the eyes, and running from the nose. Sneezing, coughing, and hoarseness may occur, various skin eruptions are not uncommon, and a curious pigmentation of the skin is nearly always observed. The patients progress until poisoning of the ends of the nerves begins, with disturbances in sensation,

anæsthesia, paresthesia, and pain. There may then develop paralysis of the extremity, frequently the toe, (drop-toe); or the wrist, (drop-wrist). Paralysis of sensation may also occur. The course of a chronic poisoning may not be over three or four days, but it usually requires three or four weeks, sometimes longer. Some individuals use arsenic throughout their lives and are never poisoned. The treatment of acute poisoning consists in the thorough and prolonged washing out of the stomach and the use of large quantities of magnesia. Supportive treatment is needed in the stage of collapse. Heat, alcohol, and coffee are indicated. In chronic poisoning electricity and tonic treatment are required.

Arse'nious Acid, the arsenical compound familiarly known and popularly called arsenic. It is obtained principally during the roasting of the arsenican nickel ores in Germany in furnaces communicating with flues. The ordinary arsenious (which is what is popularly known as arsenic) is a white crystalline powder, decidedly gritty, like fine sand, and with no well-marked taste. It is very heavy, so much so as at once to be noticeable when a paper or bottle containing it is lifted by the hand. It is soluble in water, to the extent of 1 part of acid in about 100 parts of cold water, and 1 part of acid in about 10 parts of boiling water. When placed in a spoon or other vessel and heated, it volatilizes and condenses in crystals on any cool vessel held above. By this means it can be distinguished from ordinary flour, which, when heated, chars and leaves a coal behind; and from chalk, stucco, baking-soda, tooth-powder, and other white substances, that when heated, remain in the vessel as a non-volatile white residue. In some countries, as in the mountainous regions of Austria, Styria, and the Tyrol, arsenic is eaten habitually, beginning with small doses and gradually increasing them. It is said to favor nutrition, and to improve the respiration in ascending heights. Some of the «arsenicophages» can take great quantities with impunity.

Arsen'olite, a native trioxide of arsenic, having the formula As_4O_6 (often written As_2O_3), and crystallizing in the isometric system,— usually in octahedrons. It is commonly white, with a vitreous lustre. Its hardness is 1.5, and its specific gravity about 3.71. It occurs in connection with ores of silver and lead, and with those of other metals when arsenic is associated with them. In the United States it has been found in Nevada and California. Arsenolite and senarmontite (an antimonial mineral of analogous composition and similar crystalline form) are collectively known by mineralogists as the «arsenolite group.»

Arsenopy'rite, ar-sen-o-pī'rīt («arsenical pyrites»), a tin-white, opaque mineral, with a metallic lustre, crystallizing in the orthorhombic system. It contains arsenic, iron, and sulphur, and has the formula FeAsS. Its hardness varies from 5.5 to 6.0, and its specific gravity from 5.9 to 6.2. Arsenopyrite is largely used as a source of «white arsenic,» or arsenic trioxide. It occurs chiefly in the crystalline rocks with gold and ores of silver, lead and tin. It abounds in Germany, England, and the United States.

Arsinoë, är-sĭn'ō-ē, the name of several celebrated women of antiquity, the most noted of whom is the daughter of Ptolemy I. of Egypt and Berenice: b. about 316 B.C.; she married Lysimachus, king of Thrace, in 300 B.C. Desirous of securing the crown for her own children, Arsinoë prevailed upon Lysimachus to put Agathocles, the son of his former wife, to death. This crime proved fatal to the Thracian king; for Lysandra, the wife of the murdered prince, fled with her children to the court of Seleucus Nicator of Syria, who took up arms in her favor. In the course of the war Lysimachus was slain and his kingdom taken possession of by the conqueror. Arsinoë now fled into Macedonia, which was soon overrun by the Syrian army. In less than a year afterward, however, Seleucus was assassinated by Ptolemy Ceraunus, half brother of Arsinoë. This queen, who held the city of Cassandria in Macedonia, was induced, under promise of marriage, to admit Ptolemy within its walls; but no sooner had he entered than her two children were butchered before her eyes. She succeeded in making her escape to Egypt, where she became the wife of Ptolemy II., Philadelphus, her own brother (279 B.C.), thus affording a precedent to these unnatural unions which afterward became common among the Greek rulers of Egypt. She bore no children to her brother, who, however, seems to have had a strong affection for her, as he called one of the districts of Egypt by her name and employed the architect Dinochares to build a temple in her honor.

Arsin'oë, a city of ancient Egypt, on Lake Mœris, said to have been founded about 2300 B.C., but renamed after Arsinoë, wife and sister of Ptolemy II., of Egypt. The site of Arsinoë is now occupied by the town of Medinet-el-Faium. The sacred crocodiles were kept here.

Ar'son, the malicious and wilful burning of a dwelling-house or out-house belonging to another person by directly setting fire to it, or even by igniting some edifice of one's own in its immediate vicinity. If a person, by maliciously setting fire to an inhabited house, cause the death of one or more of the inmates, the deed is murder, and capital punishment may be inflicted. When no one is fatally injured the crime is not capital, but is still heavily punishable; it is a penal offense also to attempt to set a house on fire, even if the endeavor does not succeed. The New York Penal Code provides that a person who wilfully burns, or sets on fire in the night-time, either (1) a dwelling-house in which there is, at the time, a human being; or (2) a car, vessel, or other vehicle, or a structure or building other than a dwelling-house, wherein, to the knowledge of the offender, there is, at the time, a human being, is guilty of arson in the first degree.

Many statutory changes have been made in the common law upon this subject. There are three degrees of arson in the State of New York. Arson in the first degree is punishable by imprisonment for any term not exceeding 40 years; in the second degree by imprisonment for a term not exceeding 25 years; in the third degree for a term not exceeding 15 years. Before the crime of arson is complete, the house, or some portion of it, however small, must be burned, or consumed by fire.

Art, in its most extended sense, as distinguished from nature on the one hand and from science on the other, has been defined as every

regulated operation or dexterity by which organized beings pursue ends which they know beforehand, together with the rules and the result of every such operation or dexterity.

In æsthetics, art as distinguished from science, consists of the truths disclosed by that species of knowledge disposed in the most convenient order for practice, instead of the best order for thought. Art proposes to itself a given end, and, after defining it, hands it over to science. Science, after investigating the causes and conditions of this end, returns it to art, with a theorem of the combination of circumstances under which the desired end may be effected. After receiving them, art inquires whether any or all of those scientific combinations are within the compass of human power and human means, and pronounces the end inquired after attainable or not. It will be observed here, that art supplies only the major premise, or the assertion that the given aim is the one to be desired. The grounds of every rule of art are to be found in the theorems of science. An art can then consist only of rules, together with as much of the speculative propositions as comprises the justification of those rules. Though art must assume the same general laws as science does, yet it follows them only into such of their detailed consequences as have led to certain practical rules, and pries into every secret corner, as well as into the open stores of the household of science, bent on finding out the necessities of which she is in search, and which the exigencies of human life demand. Hence, as Edmund Burke remarks, in his 'Treatise on the Sublime and Beautiful,' «Art can never give the rules that make an art.» It must always owe them to science. Whatever speaks in precepts or rules, as contrasted with assertions regarding facts, is art; and hence it always adopts the imperative mood, whereas, science almost invariably adopts the indicative. Science is wholly occupied with declarations; art is wholly engaged with injunctions that something should be done. Thus, the builder's art desires to have houses, the architect's art desires to have them beautiful; and the medical art desires to cure diseases of the human body.

In a special sense art is the practical carrying out of the principles of science; a series of rules designed to aid one in acquiring practical skill or dexterity in performing some specified kind of work, manual or mental. The several arts may be arranged in two groups — (a) the mechanical, and, (b) the liberal or fine arts. The mechanical arts are those which may be successfully followed by one who does not possess genius, but has acquired the facility of working with his hands which long practice imparts. Such are the arts of the carpenter, the blacksmith, the watchmaker, etc. They are often called trades. The liberal or fine arts are such as give scope not merely to manual dexterity, but to genius; as music, painting, sculpture, architecture, etc.

In mediæval education, the arts signified the whole circle of subjects studied by those who sought a liberal education. This included science as well as art. The seven liberal arts, which, in the palmy days of Rome, plebeians were not allowed to study, were thus divided: (1) the *Trivium* — namely, grammar, rhetoric, and logic; (2) the *Quadrivium* — namely, arithmetic, music, geometry, and astronomy. It is a remnant of this classification, which was in vogue as early as the 5th century, that we still speak of as the curriculum of arts at a university, and that graduates become bachelors or masters of arts. See ARCHITECTURE; MUSIC; PAINTING; SCULPTURE, etc.

Art, American'. The art history of America presents interesting conditions of receptivity, as well as original productivity; indeed, artistic taste, it may be claimed, was primarily transplanted or transfused into the budding art of «The Fair New World.» True to the traditions of historical repetition, the ideals of ancient Greece inspired an Italian renaissance; French, German, and English art respectively, being viewed moreover at their best periods, give evidence of having been begotten through æsthetic assimilation and fruitful appreciation of the masterpieces of Angelo, Titian, Tintoretto, Rembrandt, Rubens, Veronese, and Velasquez. The early American school not only emulated these treasured qualities of the old masters, as far as accessible in painting and sculpture of originals or in replicas, but experienced a healthful art evolution, normally stimulated by the contemporary works of Gainsborough, Reynolds, Lawrence, and others, at the close of the 18th century. It appears in accord with the artistic spirit of international reciprocity, that America provided the British Royal Academy with its second president in the personality of Benjamin West.

Although it would be intensely interesting to explore the field of Pan-American art, revealing Aztec and other aboriginal archæological relics, we are limited to the consideration of the subject co-incidental with modern art and civilization. The works of Washington Allston, Gilbert, Stuart, West, Copley, Trumbull, Vanderlyn, Jarvis, Peele, Cole, Harding; and, at a later period, of Morse, Eliot, Mount, and many others, afford invaluable examples of rare intrinsic value, with chronological evidences of the early development, impeded by all sorts of obstacles, of inborn genius and unmistakable tendencies of the American progressive element even in the province of fine art. A representative collection of the famous works by the American painters mentioned, had it been secured, would certainly to-day constitute a rare gallery of æsthetic «Americana» that well might be preserved for all time — «*con amore*» — «*pro patria et gloria*»; enkindling American art patriotism in line with that shown for the army and navy, agriculture and commercialism. It is too late, however, to secure the marvelous masterpiece by Allston, 'The Legend of the Bloody Hand,' it having unfortunately been destroyed by fire, and many other gems of renown are now lost sight of, through lack of proper preservation and of popular appreciation. Vanderlyn's 'Ariadne,' however, has fared better in company with invaluable portraits, painted by these gifted men and now in possession of the New York Historical Society. 'Marius Sitting Among the Ruins of Carthage,' a work that secured Vanderlyn, in reward for its merits, a first-class gold medal at the Paris Exposition, was a product of this period. The most important epochs of American history have been represented by native artistic talent. The sailing and landing of Columbus, the exploits of De Soto, the subju-

gation of savage life to that of civilization, Colonial and Indian warfare, the declaration of national independence, Revolutionary battles, Washington crossing the Delaware, and like famous subjects for painting and sculpture, that manifestly should be preserved by governmental direction. Although so long and disastrously belated, these facts and conditions logically suggest the formation of a national gallery of American art. The landscapes of Thomas Cole upheld, as did those of Turner, the traditions of Claude Lorraine; still in the spirit of a pioneer he proclaimed the grandeur of the primeval American forest in paintings direct from nature. His 'The Course of Empire,' now in possession of the New York Historical Society, a work that has never, we believe, been reproduced in any form, presents in four grand paintings the sway of civilization from savage life to an Arcadian period; then onward to the consummation of earthly power and magnificence; followed by the decadence occasioned by war of the elements, and that instigated by "man's inhumanity to man"; finally, the literal scene of monumental destruction and sublimely solemn desolation. Before dismissing attention called to this early period influenced, as stated, by foreign methods of technical expression, native American genius found little public appreciation; still it faithfully progressed. Again about this time matter-of-fact utilitarianism appeared to dispel the ideal artist's poetic hopes, while every encouragement followed the success of practical scientific talent. Washington Irving essayed to be a painter, but concluded to devote his life to literature and the power of the pen. Robert Fulton, who began his career as a skilful landscape and portrait painter, attracting the friendship of Benjamin Franklin, who encouraged his studies abroad, and gave him letters to Benjamin West and others, returned to his native land to find that scientific conditions were required rather than a demand for the credentials of culture in works of fine art. The result was steamboat navigation. Another triumph for science may be recorded. Franklin himself had captured lightning from the skies; still it remained for the imagination and artistic skill of the professional painter, Samuel Finlay Breese Morse, the first president of the National Academy of Design, to subjugate the marvelous electric element that joins as neighbors all mankind.

Nevertheless, the fine arts flourished; even modern travelers' tales of the wonderful scenery of two great continents stimulated artists and the lovers of art. "The Heart of the Andes," "Niagara," "The Arctic Region," "The Rocky Mountains," "The Catskills," "Lake Champlain," "Lake George," and the "Hudson River," all were delineated. Along with this demand for great subjects, often commensurate in quantity as to size of canvas with Ruskin's mathematical maxim: that the greatest work of art is the one presenting the greatest number of great ideas; there still prevailed in marked instances the glorious traditions of full-habited oil-painting to be found in the æsthetics of familiar environment of earth, air, and water, as embodied in artistic values and soulful qualities — creations in harmony with Michel, Ruysael, Constable, and the masters of Barbazon and Fontainebleau. Again, while scientific influences appear in the works of Durand, Church, Casalear, and Kensett, they asserted a truly American artistic individuality; they copied directly from nature. They thought of no school nor technique, but carefully imitated what they saw. All these men with one exception had been practical engravers, laying down the burin and the needle-point to take up the pencil and the brush. Their respective biographical and æsthetical records in American art will be enduring; yet there comes the reflection that had their professional training been more liberal and adequate they would have attained to higher things. The importance of masterly academic training cannot be overestimated; as a means to an end, however great, education is the only acknowledged guide for the individual artist and for the community even in matters of taste. Nothing is more creditable to a civilized people than its credentials of culture. The formation of a fine art association in its chief city was at the beginning of the past century an occasion of vast importance to our commonwealth. The first action was taken in 1802 by a few prominent citizens, and six years later a charter was obtained with the name of The American Academy of Arts. The first officers under this charter were Robert Livingston, president; John Trumbull, vice-president; DeWitt Clinton, Dr. David Hosack, John R. Murray, William Cutting, and Charles Wilkes, directors. A school was equipped with casts brought from Paris by Mr. Livingston, and exhibitions of paintings and statuary were held for a time in an unused riding school in Greenwich Street near the Battery. Public interest in this movement was soon transferred to grand panorama schemes conducted by Vanderlyn at the "Rotunda," and by others with similar enterprises. It was not until the year 1826 that the artists themselves, with Morse as president, founded the National Academy of Design in the earnest interests of American art, with educational purposes and exhibitional facilities; its influence increasing until the present day. Its membership consists of one hundred academicians and an equal number of associate members, including the most distinguished painters and sculptors of America. Its list of fellowship for life likewise includes the most prominent public-spirited patrons of American art.

Established for many years in the Academy building, tastefully modeled after the Palais Ducal of Venice and forming an attractive urban landmark, lack of accommodations for its growing schools, and crowding commercial surroundings, required a move to more suitable quarters. Unlike the Royal Academy of London, with its plethoric treasury, and similar institutions situated in other European art centres, the academy is without governmental endowment, and may well enlist American art patriotism in the cause of æsthetic culture in fostering the fine arts of painting, sculpture, and architecture. Other societies of American artists, water color societies, and architectural leagues make annual exhibitions in New York; while art institutes throughout the United States, in various cities attest the extent and importance of American art. We, as Americans, are an artistic people, cosmopolitan, and composite, uniting the genius of all nations. The æsthetic field of general American artistic taste and industry has been strenuously productive. The

ornamental, orderly, and decorative work in clay, on china, glass, wood, and stone as a tasteful and profitable divertisement, begins with the training of the kindergarten. Black and white illustration and etching has been awarded first-class medals at home and abroad. The beautiful and refined exemplified in aguarelle and oil-painting, in portraiture, genre, and pastoral; in sculpture and architecture; and finally the grand and sublime of high art, all confirm the achievements of American art and artists.

In advancing these three divisions,— the ornamental, the beautiful, and the sublime,— as a guide, we approach the philosophical consideration of the subject of fine art. What is, and what is not, fine art? Shakespeare's injunction "to hold, as it were, the mirror up to nature" is the best artistic advice ever given. Bacon in his essay is not so direct. He asks which is the greater trifler, one who would make a personage by geometrical proportions (perhaps by the fabled Greek cabala) or another who would select the best parts of divers faces to make one excellent (a veritable composite picture)? He concludes at last that: a painter may make a better face than ever was, but he must do it by a kind of felicity, as a musician who makes an excellent air in music, not by rule. If ever there was an artist he was Shakespeare — if ever there lived a scientist, Lord Bacon was, perhaps, the most eminent, and in their respective views and definitions we find the differentiation between science and art. In any given work in so far as it may be mechanically constructed is presented a scientific product; and in so far as reproductive processes may exhaustively duplicate it, it falls short of the possibilities of fine art. An etching by a master may be an autographic art creation; but when it is possible through photography, photo-gravure or chromo-lithography to so perfectly duplicate a painting, that the reproduction presents all the merits of the original, it may be realized to science rather than be accepted as genuine fine art. True consummate mechanism must ever go hand in hand with fine art; still a great work of art presents the maximum of art to the minimum of mechanism. A painting portraying living objects with a sharp contour, such as may delight the photographer, without the suggestive quality of stereoscopic relief, does not hold the mirror up to nature, and the work may be classed with scientific achievements even if accredited to the consummate mechanism of a Messonnier. Indeed reproductive processes have served a great purpose in defining the line of demarcation between science and art. Affectations have been swept away by a revelation of their superficiality; while the possibilities of inimitable fine oil-painting, a medium and technique that, of all ever employed, has the fewest possible limitations, have been enhanced as seen in the works of the American artists already mentioned; and in those of a growing group of American idealists, colorists, and tonalists. Various have been the fashions or "isms" that have dominated American art at different periods of its history. Preraphaelitism as advocated by Ruskin was one of the earliest imported. Being appointed the legal executor of his hero-client, as well as being an enthusiastic admirer of his work, Ruskin claimed for Turner not only the grander qualities, but a command of detail that rivaled the ancients, although the artist, we are told, frankly declined the compliment. Turner was unquestionably the greatest modern master of decorative and scenic effect in pictorial combinations representing earth, air, and water, being, indeed, entitled to the apotheosis of synthesis; still diligent search in the archives of the Royal Academy and National Gallery fails to reveal the qualities attributed to him by the author mentioned. Ruskin's enthusiasm proved contagious throughout the art circles of England and America; solicitous friends as well as the most influential art writers pleaded with the tyro to emulate not the work of Michael Angelo, Titian, or Raphael himself, but to follow in the footsteps of Perugino and Raphael's father or grandfather. This verily seemed like unto the dotage of imbecility in the light of Raphael's glorious art that had evolved the immaculate Sistine Madonna. He was brave, indeed, in the field of American art of that day, who could resist the popular and professional pressure of this pseudo-æsthetic movement. No vestige of it remains, and no wonder it was followed by impressionism — as a free and joyous transition from mechanical restrictions in art. This was the artistic attempt to present the maximum of soulfulness conveyed to the world by finest art; employing the minimum of materiality and mechanism as seen in the rendition through mental vision of the fleeting sunset or twilight — such as may only be materialized on the morrow; the epitomization perhaps of a day's outing under the open skies or flying clouds, or in the sublime thunder-storm; in fact, the entire realm of imagination is unfolded by artistic impression. Such was the accepted province of genuine impressionism originally as associated with the artistic convictions and poetic spirit of Corot, Monet, Monticelli, William Hunt, William Page, George Fuller, and many others. Impressionism naturally evolves symbolism and idealism, but in too many instances has deteriorated into affectation and mysticism. Premeditated and assumed mysticism is the *dernier-ressort* of mediocre painters and sculptors, as well as of the minor poets. It may not be mistaken for sublime spirituality. Dante, Shakespeare, and Milton, treating even divine themes, never nebulized their ideas in mysticism; the same may be said of Bryant and Longfellow; while Poe, temperamentally, a mystic solitudinarian, in the field of poetic art presented the apotheosis of spirituality.

The crowning glory in the art of any civilized country is that of naturalism. In the truest sense it utilizes even scientific "disjecta membra," as enumerated, and subjugates the same to the entirety of art. The comprehensive structural organic presentation of material nature, suggesting the qualities of size, form, weight, color, and perspective values; chiaroscuro, and, above all, the ultimatum of expression and tone. These enduring qualities characterize the art of Innis, Martin, Wyant, Hunt, and Page, and the growing group of American tonalists of the naturalistic school. A great advantage exists in American art from its cosmopolitan resources. In Paris one sees nothing but French art; in Munich, the German school; in London, English art, while the art institutions of America contain specimens of masterpieces from every

source, notably the collection of the Metropolitan Museum of Art, and art institutes of Brooklyn, Boston, Chicago, Philadelphia, and Pittsburg, as well as collections in all our large cities. While every art centre of Christendom seems to be provided with an American colony of artists and students, expatriation is no longer a necessity in order to obtain an education in fine art. The Academy and various art student leagues are conducted by eminent instructors distinguished with every honor obtainable at home or abroad. The prospects of a greater appreciation of American art open with the new century, as interest in the pursuits of peace should naturally follow national expansion. Advocacy of our chief art educational institutions is a feature of metropolitan aggrandizement; millions have been given to libraries and various institutions of learning; and fine art should be included with erudition, as the essential credential of culture. Timely attention may be called to the requirements of the pioneer American art institution, founded by the immortal Morse and his co-workers eminent in art instruction, and being associated with the career of America's greatest masters in painting, sculpture, and architecture. In accord with urban expansion it has departed from its classical landmark, a diminutive «Palais Ducal,» to a most accessible and beautiful site, upon the acropolis of the metropolis, facing Cathedral Driveway, Morningside Park, New York city. As the leading exponent of American art instruction, through schools and exhibitions, it is planned to erect an edifice that shall do justice to the artistic taste of the New World's metropolis, and to the original National Academy of Design.

The Department of Commerce just established by the general government is a step in the right direction of national affairs, and may make clear the way for the proposed Department of Art and Industries. It has been repeatedly advocated and constant evidences of its requirement as an absolute necessity have been presented to the government and to the people; still it is being detrimentally delayed. The appropriations for national and international expositions have repeatedly been used in a manner giving anything but satisfaction. Commissions and contracts for statuary, monuments, and architecture that should receive the supervision of expert art judgment are left to provisional committees of statesmen, who frankly admit their inability to judge in the affairs of fine art. The disastrous experiences resulting from this careless management of each and every international exposition, including the Centennial, the New Orleans, the Chicago Columbian, and the Buffalo Pan-American, certainly teach that no similar enterprise should be thrust upon the community for co-operation through flattering prospectuses, promises of profit, etc., until matured and definite plans and specifications shall have been officially inspected, approved or rejected by the projected national department of art and industries; this would also provide a valuable bureau of information in art affairs, enabling legislator and citizen to act or vote intelligently in regard to any appropriation, commission or tariff. The practical utility and public good to be derived from such a department may be demonstrated in many instances. A member of Congress having been appointed upon a committee assigned the duty of supervising the ground immediately surrounding the House of Representatives was astonished to find that millions of dollars had been expended upon the same; each new committee annually appointed having exercised its taste and judgment on the important matter. It was concluded that the advice of an expert landscape architect be secured, and this being done, the expenditure was practically ended. Again the enormous expense of indiscriminate illustration of congressional and department literature or printed matter has, to-day, caused anxiety and criticism. So in relation to all official cases requiring expert art supervision, eclectic sense and æsthetic taste should be at the service of the government. The plan involves no untried innovation; the French nation has its Minister des Beaux Arts, who is a member of the Cabinet of the Republic of France, leading the world in art affairs, taste and fashion. The establishment of Municipal Art Commissions is a step in the right direction. The task of correcting the contour of metropolitan architecture seems, indeed, herculean; individual buildings of great beauty are adjoined by the most heterogeneous structures; a three-story house appears between one of eight and a sky-scraper of twenty. In no capital of Europe would such incongruities be permitted, and every possible facility should be afforded our Municipal Art Commissions to correct this chaotic condition. Victor Hugo said «the beautiful is as useful as the useful, more so, perhaps.» European municipal politics profit by the practical application of this fact; great cathedrals, public statuary, and fountains, picture galleries and museums attract multitudes of tourists, thereby financially as well as æsthetically benefiting communities that keep in the vanguard of culture and civilization.

Bibliography.— Allston, 'Lectures on Art and Poems'; Clara Clement and Lawrence Hutton, 'Anecdotes of Painters, Engravers, Sculptors, and Architects'; Cummings, 'Annals of the National Academy of Design'; De Muldor, 'The Philosophy of Art in America'; Dunlap, 'History of the Rise and Progress of the Arts of Design in the United States' (2 vols.); Kohler, 'American Art'; Sheldon, 'American Painters.'

CHAS. H. MILLER, N. A.
Municipal Art Society, New York.

Art Education. See ARCHITECTURE, EDUCATION IN; PAINTING, EDUCATION IN; SCULPTURE, TEACHING OF.

Art, History of. See FINE ARTS.

Art, Metropolitan Museum of, a spacious edifice in Central Park, New York, erected by the city for the purpose to which it is devoted. It was incorporated in 1870, and possesses an art collection amounting in value to over $2,000,000, including the Cesnola collections. The treasures to be found here are various in character and of most profound interest, especially the ancient sculptures and relics from the island of Cyprus. These, in the study of antiquities, are of much value, and many of the other departments likewise possess rare attractions.

Art of Poetry, The ('Ars Poetica'), a famous work by Horace. This is not the name given it by its author, who called it merely a

‹Letter to the Pisos.› Horace treats of the unity that is essential to every composition, and the harmonious combination of the several parts, without which there can be no lasting success. In the second part, the poet confines himself to the form of the drama, the principles he has already established being so general that they apply to every class of composition.

Art Unions, a name applied to associations for the encouragement of the fine arts by the purchase of works of art out of a common fund raised by small subscriptions or shares, and their distribution by lot. The first art union was started in France; but the Munich art union was the first of importance. Berlin and other towns of Germany soon followed the example of Munich, and the first art union was founded in Edinburgh in 1834, and proved a complete success. The art union of London soon followed that of Edinburgh.

Arta, är'ta, the name of a gulf, town, and river. The gulf (ancient *Ambracius Sinus*), an arm of the Ionian Sea, between Greece and Albania, is about 20 miles long by 10 miles broad. Near its entrance the battle of Actium was fought. The town, called also Narda (the ancient *Ambracia*), about six miles north of the gulf, stands on the river, which is here about 200 yards wide, and begins to be navigable. It carries on a considerable trade in wine, oranges, and tobacco. Pop. (1896) 7,582.

Ar'taba'nus IV., the last of the Parthian monarchs, who 217 A.D., escaping with great difficulty from a perfidious massacre begun by the Romans under Caracalla, mustered an army, and engaged his foes in a battle which lasted for two days. Peace was then concluded, but Artabanus afterward incited his subjects to revolt, and in a battle, in 226, was taken and put to death.

Ar'taba'zus, the name of several distinguished Persians under the dynasty of the Achæmenidæ. When Xerxes advanced against Greece, an Artabazus led the Parthians and Chorasmians. Another Artabazus was general under the Persian king, Artaxerxes II., and afterward revolted against Artaxerxes III. He was forgiven through the exertions of his brother-in-law, Mentor, a favorite and staunch supporter of the next king, Darius, whom Artabazus faithfully attended after the battle of Arbela. Alexander rewarded his fidelity by appointing him satrap of Bactria.

Artagnan d', där'ta-nyän', the hero of Dumas' ‹Trois Mousquetaires,› Vingt ans après, and Le Vicomte de Bragelonne.› He is a Gascon adventurer, very popular among heroes of romance. There was, however, a Count d'Artagnan (b. about 1612; d. 1673), who was an officer of musketeers, and fell in the siege of Maestricht.

Artasires, (är'ta-väs'dēz) the last Arsacid monarch of Armenia. He was placed on the throne by Bahram V. of Persia, who afterward deposed him and annexed his dominions to Persia, under the name of Persarmenia, 248 B.C.

Artavasdes (är'ta-väs'dēz) **I.,** a king of Armenia, who succeeded his father Tigranes. He joined the Roman forces commanded by Crassus, but deserting to the enemy, caused the defeat of the Romans, and the death of Crassus. He similarly betrayed Mark Antony when engaged against the Medes; but afterward falling into Antony's power, was taken with his wife and children to Alexandria, where they were dragged at the victor's chariot wheels in golden chains. After the battle of Actium, Cleopatra caused his head to be struck off and sent to the King of Media.

Artax'ata, the name of the ancient capital of Armenia, the refuge of Hannibal when forsaken by Antiochus. Its ruins are now known as Ardashir.

Artaxerxes, är'täks-ėrks'ēz, the name of several Persian kings: (1) ARTAXERXES I., surnamed LONGIMANUS, because his right hand was longer than his left, the second son of Xerxes, escaped from Artabanus and the other conspirators who had murdered his father and elder brother Darius, and in 465 B.C. ascended the throne. He conquered the rebellious Egyptians, terminated the war with Athens by granting freedom to the Greek cities of Asia, governed his subjects in peace, and died 425 B.C. (2) ARTAXERXES II., surnamed MNEMON, from his strong memory, succeeded his father, Darius II., in the year 405 B.C. After vanquishing his brother Cyrus he made war on the Spartans, and forced them to abandon the Greek cities and islands of Asia to the Persians. He favored the Athenians, and endeavored to foment dissensions among the Greeks. His last days were embittered by the unnatural conduct of his son Ochus, who, to secure the crown to himself, caused the destruction of two of his brothers. On the death of Artaxerxes Mnemon, 359 B.C., Ochus ascended the throne under the name of (3) ARTAXERXES OCHUS. After having subdued the Phœnicians and Egyptians, and displayed great cruelty in both Egypt and Phœnicia, he was poisoned in 339 by his general, Bagoas. (4) ARTAXERXES BEBEGAN was the first king of Persia of the race of Sassanides. He was a shepherd's son; but his grandfather, by the mother's side, being governor of a province, he was sent to the court of King Ardavan. On his grandfather's death, Artaxerxes, exciting the people to revolt, defeated and slew Ardavan and his son, and assumed the title of King of Kings. He made vast conquests, and wisely administered the affairs of his kingdom.

Artedi, är-tā'de, **Peter,** an eminent Swedish naturalist: b. Anund, 22 Feb. 1705; d. Amsterdam, Holland, 27 Sept. 1735. He went in 1724 to Upsala, and turning his attention to natural history, soon rose to considerable eminence, particularly in the department of ichthyology, the classification of which he reformed upon philosophical principles. This arrangement added greatly to his reputation as a naturalist at the time, and afterward became popular over Europe. In 1728 his celebrated countryman, Linnæus, arrived in Upsala, and a lasting friendship was formed between the two men. In 1732 both left Upsala — Artedi for England, in pursuit of his favorite study; and Linnæus for Lapland, to examine its natural productions; but before parting they reciprocally bequeathed to each other their manuscripts and books upon the event of death. According to agreement his manuscripts came into the hands of Linnæus, and his ‹Bibliotheca Ichthyologica› and ‹Philosophia Ichthyologica,› together with a life of

the author, were published at Leyden in the year 1738. Linnæus named a genus of umbelliferous plants Artedia, in memory of his friend.

Arte'mia. See Brine-Shrimp.

Ar'temido'rus, a Greek geographer: b. in Ephesus, who flourished about 100 B.C. His 'Geographoumena' in clever books was an exhaustive work on the various features, geographical, physical, historical, and political, of the larger part of the then known world, founded on the writer's own investigations and the works of preceding writers. Only fragments of his work are extant.

Ar'temis, a Greek goddess, identified with the Roman Diana. She was the daughter of Zeus (Jupiter) and Leto or Latona, and was the twin sister of Apollo, born in the island of Delos. She is variously represented as a huntress, with bow and arrows; as a goddess of the nymphs, in a chariot drawn by four stags; and as the moon goddess, with the crescent above her forehead. She was a maiden divinity, demanding the strictest chastity from her worshippers, and is represented as having changed Actæon into a stag, and caused him to be torn in pieces by his own dogs, because he had secretly watched her as she was bathing. The Artemisia was a festival celebrated in her honor at Delphi. The famous temple of Artemis at Ephesus was considered one of the wonders of the world, but the goddess worshipped there was very different from the huntress goddess of Greece, being of Eastern origin, and regarded as the symbol of fruitful nature.

Artemisia I., är'te-mĭzh'i-a, or mĭsh-ĭ-ă, a queen of Caria, who lived in the 5th century B.C., and assisted Xerxes in person against the Greeks, and behaved with such valor that the Athenians offered a reward for her capture, and the Spartans erected a statue to her.

Artemisia II., a queen of Caria, who flourished about 350 B.C. She was the sister and wife of Mausolus, whose death she lamented deeply, and to whom she erected, in her capital, Halicarnassus, a monument reckoned among the seven wonders of the world. The principal architects of Greece labored on it. Bryaxis, Scopas, Leochares, and Timotheus made the decorations on the four sides of the edifice; Pythes, the chariot drawn by four horses, which adorned the conical top. Vitruvius thought that Praxiteles was also employed on it. After the death of Artemisia the artists finished it without compensation, that they might not be deprived of the honor of their labor. It was an oblong square, 411 feet in compass, and 130 feet high. The principal side was adorned with 36 columns, and 24 steps led to the entrance.

Artemisia, a genus of aromatic, acrid, and bitter flavored herbs and shrubs of the natural order *Compositæ,* mostly natives of the northern hemisphere and especially abundant in arid regions. The species are characterized by alternate often deeply-lobed or divided leaves, and numerous small and generally inconspicuous heads of yellow or whitish florets. The cultivated species, of which there are many, are readily propagated by division and succeed even on poor dry soils. *A. dracunculus,* tarragon or estragon, is a Siberian perennial, long and widely cultivated in Europe, but little in America, for its leaves, which are used to season dressings, pickles, and other culinary preparations. (See Tarragon.) *A. absinthium,* wormwood, a native of Europe and Asia, is a spreading and branching perennial herb, 2 to 4 feet tall, with its two- or three-parted silky-downy leaves, and its flower-heads in axillary panicles. It is widely grown in Europe for the manufacture of absinthe (q.v.). *A. abrotanum,* southernwood, old man, is a shrubby species, 3 to 4 feet tall, a native of middle Asia and southern Europe, and is often grown for its pleasant-smelling foliage, which is used among clothing as a moth repellant, and in parts of Europe in the manufacture of some kinds of beer. *A. pontica,* Roman wormwood, another European species, resembles *A. absinthium* in properties and is similarly used. *A. vulgaris,* mugwort, is a native of Europe and northern North America, grown for its pleasant-smelling ornamental foliage, which in some varieties is golden or variegated. Its young shoots and leaves are used in German cookery, and like *A. absinthium,* in domestic medicine. *A. stelleriana,* old woman, a native of northeastern Asia and common on the Massachusetts coast, is a useful border plant on account of the whiteness of its foliage. *A. arbuscula,* a species seldom more than one foot tall, and *A. tridentata,* which though usually low growing, occasionally reaches a height of twelve feet, are representative of the many species known as sage brush (q.v.) in the arid districts of the western United States, where they furnish valuable forage for cattle and especially sheep. *A. mantima* and several other species are grown for their flower heads, which are used in medicine as a vermifuge and sold under the name of worm seed or as santonine, the colorless crystalline active principle. *A. moxa, A. chinensis,* and other species furnish moxa, a cottony material obtained from the leaves which are covered with down, used by the Chinese for cauterizing. Numerous other species are employed in the manufacture of absinthe, for culinary, ornamental, and medicinal purposes in various parts of the world. For physical action and toxicology, see Absinthe.

Artemisium, är-te-mĭsh-ĭ-um, a promontory in Eubœa, an island of the Ægean, near which a great naval battle between the Greeks and Persians was fought, 480 B.C. It was named from a temple to Artemis situated here.

Ar'temus Ward. See Browne, Charles Farrar.

Arte'rial Pressure. See Blood Pressure.

Ar'teries, the vessels in the human body that carry arterial, or oxygenated blood away from the heart. The old name, signifying carriers of air, is retained, although the ancient belief has been laid aside. The arteries spring from the heart, as the aorta (q.v.) and by the branching and division of the main branches of this large arterial trunk, are distributed in successively finer branches to all parts of the human body. The blood supply for the head is mainly derived from the carotid arteries, the superficial, or external carotid, supplying the outer structures, and the deep or internal carotid that gives nourishment to the brain and deeper lying parts. There are numerous anastomoses between the branches of the carotid arteries. The main sup-

ply of the arm has been described under the head aorta (q.v.), as well as the branches that supply the viscera and the lower limbs. Arteries become smaller and smaller as they approach the periphery of any organ and are finally converted into capillaries which anastomose with the capillaries of the veins; these carry the blood back to the heart and thus the circle is completed. The minute structure of the arteries is well adapted to the varying functions that these vessels perform. In every large and medium-sized artery, three distinct layers or coats may be distinguished under the miscroscope. The inner coat, or the *tunica intima,* is thin and smooth, and consists of an inner layer of flat plate-like endothelial cells that are continuous throughout the entire system of blood vessels. This endothelial layer by its smoothness reduces friction of the flowing blood to a minimum. Surrounding it are two layers of fibrous elastic tissues. The middle coat of the arteries is the *tunica media* and is composed mostly of smooth muscle fibres, with some fibrous tissue. These muscle fibres are arranged in a circular manner about the arteries. The outer coat, or the *tunica adventitia,* is made up of white fibrous tissue. Thus the arteries have elastic and fibrous tissues in each coat. The outer layer is extremely tough and thus strengthens and protects; the middle layer by means of its elasticity permits the artery to return to its average diameter after it has been dilated or contracted by the muscular layer. In the larger arteries the yellow fibrous tissue predominates, while in the smaller arteries there is a relatively larger amount of muscle fibre. The large arteries are thus more elastic and less contractile, while for the smaller arteries the reverse is true. The muscle fibres are under the control of the sympathetic nervous system nerve fibres. In the capillaries the artery is reduced to its single endothelial layer, and has neither elastic fibres nor muscle fibres.

Arteries, Diseases of. The arteries are subject to a number of diseases which may be classed as (1) due to infectious micro-organisms, (2) degenerations with increase of connective tissue, (3) aneurisms. Of the acute infectious diseases, tuberculosis and syphilis, particularly the latter, are important. Syphilis is one of the most important causes of arterial degeneration. *Acute arteritis* is a definite disease, although the great pathologist, Virchow, taught that it was a secondary affection. Recent bacteriological studies, however, have shown that bacterial infection of the arterial walls is a fundamental and important process. It is frequently the cause of an arterial thrombus and often develops into a true arteriosclerosis. Under the general head arteriosclerosis is classed a diffuse or circumscribed thickening of the arterial walls, especially of the *tunica intima,* secondary to inflammatory or degenerative changes in the *tunica media.* When occurring in the large arteries, the term *atheroma* is used. Arteriosclerosis is sometimes found in the young, but is usually a disease of later life. Among the causes favoring its development are: (1) changes in the composition of the blood, such as toxins from bacterial infections (syphilis, rheumatism), metallic poisons, alcohol, and the disturbed metabolism of gout, Bright's disease, etc., and (2) changes in the tension of the blood vessels. These occur as a result of excessive and prolonged muscular exertion and intense emotional activity. Arteriosclerosis may be circumscribed or diffuse. It may show irregular plaques of a transparent or gelatinous character which at a later period become hard and firm, or even calcified with the formation of brittle or pipe stem arteries. Sometimes the arteries undergo a fatty degeneration. There is a proliferation of the connective tissue and a degeneration of the elastic tissue. The arteries thus become less responsive to control and so interfere with the nervous impulses. In the diffuse form the proliferation and degeneration is more uniform. Arteriosclerosis is one of the most important of all diseases since by its interference with the proper blood supply of an organ, it may occasion disease in that organ. In pronounced generalized arteriosclerosis all of the organs of the body suffer. Arteriosclerosis is one of the most important elements in the production of cerebral hemorrhage, one of the forms of apoplexy. Aneurisms have already been considered under that heading.

Arte'riosclero'sis. See ARTERIES, DISEASES OF.

Artesian (är-tē'zhăn) **Wells,** borings of considerable depth which tap a subterranean stream or sheet of water. The name is derived from artois (Latin *artesium*), a province in France where the first deep borings in Europe were made. Strictly speaking the term artesian is applicable only to such wells as discharge water at the surface under natural conditions (that is, self-flowing wells), but in America the term is commonly applied to any wells of more than ordinary depth. As the latter type of wells does not possess any features of special interest the term will here be used in its limited sense. The conditions which determine the presence of artesian water in a region relate to the geological structure of the underlying strata. It is essential in the first place that a pervious stratum enclosed above and below by impervious layers be present. The pervious bed, usually sandstone or sand, serves as a reservoir for the accumulation of water, while the impervious beds prevent this water from escaping either upward or downward. The second requisite is that the strata have a gentle pitch toward the site of the well and that they outcrop at some place above the mouth. The distance of the outcropping edges, which receive the water supply from rains, is sometimes very great, and is immaterial if the enclosing beds are perfectly impervious, except as it modifies the resistance offered to the passage of the water. Owing to this friction the water column of the well never reaches the level of the outcropping source. The conditions for artesian water are particularly favorable when the strata are arranged in the form of a geological basin dipping in all directions toward the well, as there then is no opportunity for the water to escape at a lower level. From these considerations it is evident that the discharge from an artesian well depends upon the rainfall of the region and upon the area of the exposed porous stratum. At first the discharge is usually very abundant owing to the long accumulation, and unless this drain is constantly supplied the flow will gradually decrease until a balance is established. When several wells are bored in the same vicinity, the flow from each may be diminished, but the total discharge will increase until the limit of supply is reached. This is

well illustrated in the wells bored in the London basin which in 1838 gave a total daily supply of 6,000,000 gallons; in 1851 with a larger number of borings the supply was about doubled, while the force had diminished very markedly. Artesian water is valuable not only for domestic use, for which it is usually adapted by its purity, but it is also extensively employed in the irrigation of arid regions. Some parts of the Sahara Desert have been reclaimed by making use of the subterranean stores of water, and recent investigations have shown that there are many areas which may yet be brought under cultivation. It is, however, in the United States that irrigation by artesian waters has reached its greatest development. Special surveys of the Great Plains region have been undertaken by the United States Geological Survey for the purpose of defining the areas where successful borings may be made, and artesian wells are now largely employed for irrigation in Kansas, Iowa, Colorado, Montana, and Texas. The supply is drawn mostly from the Cretaceous sandstone, which is reached at a depth varying from less than 100 to more than 1,500 feet. When the flow of water is sufficiently strong it may be utilized for power purposes as is done in some parts of Europe. In Würtemberg a supply of warm water is applied to the heating of buildings.

The depth at which artesian water may be found depends entirely upon local conditions. In the Paris basin the water-bearing stratum is usually encountered at a depth exceeding 1,500 feet. The famous well at Grenelle, near Paris, was begun in 1833, and operations were continued until 1841 when at a depth of 1,797 feet the water poured out with great force at the rate of 500,000 gallons per day. Another well was sunk near by at Passy, which yielded 5,600,000 gallons daily, the water rising to a height of 54 feet above the mouth. This well was 1,923 feet deep and had the unusual diameter of 2 feet 4 inches. A well at Kissingen, Bavaria, furnishes a supply of saline water from a depth of 1,878 feet. The deepest well in the world is at Schladenbach, near Leipsic, 5,735 feet. In the United States there are many notable examples of artesian wells. The first boring of great depth was made at St. Louis in 1849–54; a flow of 75 gallons per minute was obtained from a depth of 2,200 feet, but the water was so heavily charged with sulphuretted hydrogen and mineral matter as to be unfit for domestic use. Another boring was subsequently made to a depth of 3,843 feet. A well at Louisville, Ky., is 2,086 feet deep and yields 330,000 gallons per day. Among other noteworthy wells are the following: Columbus, O. (2,775 feet); Galveston, Tex. (3,071 feet); Charleston, S. C. (1,250 feet); Pittsburg, Pa. (4,625 feet); and Chicago (710 feet). A great many wells have been bored in recent years within the Atlantic Coastal Plain, especially in New Jersey, and many cities have thus obtained supplies of pure water. The cost of sinking artesian wells varies with the depth and the character of the strata encountered. Up to 500 feet the cost commonly ranges from $1.50 to $3.00 per foot, but below this limit the cost increases in proportion to the depth. The apparatus used in boring does not differ from that employed in sinking for petroleum. The first artesian borings were probably made by the Chinese. In the upper basin of the Yang-tse-Kiang there are wells 1,500 to 3,000 feet in depth from which brine for salt manufacture is obtained. This industry has been carried on since a very early period and is an illustration of the comparatively advanced state of progress attained by this people long before the western nations had developed the mechanical arts beyond the crude stage. Deep wells have been found also in Egypt which are thought to have been the work of the ancient Egyptians. A well bored in the year 1126 at Lillers, department of Pas-de-Calais, France, is still flowing.

Arteveld, är'tĕ-vĕl'dĕ, or **Artevelde**, the name of two men distinguished in the history of the Netherlands. (1) Jacob van, a brewer of Ghent, b. about 1290; d. 17 July 1345. He was selected by his fellow townsmen to lead them in their struggles against Count Louis of Flanders. In 1338 he was appointed captain of the forces of Ghent, and for several years exercised a sort of sovereign power. A proposal to make the Black Prince, son of Edward III. of England, governor of Flanders, led to an insurrection, in which Arteveld lost his life. (2) Philip van, son of Jacob: b. 1340; d. 27 Nov. 1382. At the head of the forces of Ghent he gained a great victory over the Count of Flanders, Louis II., and for a time assumed the state of a sovereign prince. His reign proved short-lived. The Count of Flanders returned with a large French force, fully disciplined and skilfully commanded. Arteveld was rash enough to meet them in the open field at Roosebeke, between Courtrai and Ghent, in 1382, and fell with 25,000 Flemings. See Ashley, 'James and Philip van Artavelde' (1883); Hutton, 'James van Artavelde' (1882).

Artevelde, Philip van, the title of a tragedy by Sir Henry Taylor, published in 1834. It is one of the best of modern English tragedies by an author distinguished for his protest, in the spirit of Wordsworth, against the extreme sentimentalism of Byron. In this play with admirable power he brings back the stress and storm of 14th century life. The father of Philip, the great Jacob van Artevelde, an immensely rich brewer, eloquent and energetic, had played a great part as popular leader at Ghent, 1335–45; and it fell to his son to figure similarly in 1381, but to be slain in a great defeat of the forces of Ghent the next year. Taylor's tragedy recalls the events of these two years.

Art'ful Dodg'er, The, the nickname of John Daukins, a young pickpocket in Dickens' 'Oliver Twist.'

Arthralgia (Neo.-Lat. from Gr. ἄρθρον, joint, + ἄλγος, pain), pain in a joint; used more specifically of neuralgia in a joint. It is synonymous with arthrodynia.

Arthri'tis, an acute or chronic inflammation of the joints, usually due to bacterial infection. Such infection may follow a wound, a perforating injury, an operative incision, or the micro-organisms may come to the joint through the blood stream, as in rheumatism, gonorrhœa, typhoid, or pyemia. In some cases of arthritis the causes seem to be resident in defective metabolism — gout is an illustration of this type of arthritis. In acute cases there are pain, swelling, heat, and occasionally suppuration. In the chronic forms the main symptoms are pain and

stiffness. The treatment should include rest, counter-irritation, and, in the suppurative cases, prompt surgical attention. In the more chronic cases counter-irritation, dry, hot air, static electricity, and potassium iodid are of service. See ANTHRITIS DEFORMANS; GOUT; JOINT; RHEUMATISM.

Arthritis Deformans (rheumatoid arthritis, or osteo-arthritis), a chronic progressive disease of the joints, chiefly affecting the articular cartilages, bones, and synovial membranes, and producing loss of function and great deformity from ossification of some parts of the joint and atrophy of others. Its origin is not definitely known. Though it is sometimes spoken of as rheumatic gout, it is believed to have nothing in common with rheumatism or gout, but may co-exist with either.

It is very rare in children, occurs occasionally in old age, is more common between 25 and 50, and in females than in males. It most often appears after the menopause, though it may occur earlier, as when following parturition. It is doubtful whether the disease is hereditary, although several cases may occur in one family. Exposure to inclement weather, dietetic errors, injuries, etc., have less causative influence than in gout or rheumatism, but poor food, debility, anæmia, and cold and damp increase the severity of the disease. Mental strain precedes many cases and adds very much to the severity of the disease.

There are two theories as to the immediate cause of the affection. The first, the nervous or neuropathic theory, is based upon the symmetrical distribution of the joint-lesions, the trophic changes in the skin, nails, etc., the frequent pre-existing mental disturbances, shock, grief, worry, and the like, the disproportionate muscular atrophy, and the similarity of the lesions to those of locomotor ataxia and other affections of the spinal cord. The second or infectious theory is derived from the facts that micro-organisms have been found in the fluids and tissues of the joints, that the disease sometimes begins with an acute onset, as do many of the infectious diseases, and that enlargement of the spleen and lymph-glands is found in some cases. It is difficult to say which tissue is primarily at fault, but sooner or later nearly all are involved. The synovial membrane inflames, and papillary outgrowths and cartilaginous nodules form upon it. These last may undergo fatty degeneration, or they may ossify. They may slip into the joint-cavity. If serous effusion occurs it is absorbed early in the disease. The cartilages lose their cells, become fibrillated and soft, and are removed by friction and absorption. The ends of the bones (the interarticular cartilages being absorbed) by friction become smooth, rounded, and shiny, like polished ivory (eburnated). The eburnated surfaces, by attrition, become grooved, and minute perforations of the Haversian canals result. Deposits of new bone form around the margins of the joints, and may be often felt externally. The muscles atrophy and are of a brownish color. Fibrous adhesions and bony anchylosis occur. Some of the small joints of the fingers, for example, may move a little, but the knees, etc., may be interlocked, by reason of the rims of bony material deposited. Dislocation or subluxation may result. The periosteum along the shafts of the bones may thicken or ossify in nodules.

The acute form of the general or multiple progressive type is rare after 40. Smaller joints become simultaneously painful, tender, and swollen, but not red as in rheumatism; there is no migration from joint to joint, the affected joints are inflamed, while others are becoming diseased. Patients are anæmic, mentally depressed, and complain of headache and malaise. Fever seldom goes above 102°. Temporary improvement occurs, but the disease advances. The chronic form of this type is insidious and more common. One joint (of finger or toe) is involved; the disease affects the corresponding joint, and then other joints; pain may be mild or very severe; there are delusive intervals while the disease marches on. After months, or it may be years, all or nearly all of the joints are thickened, rigid, and distorted. The hands are bent toward the ulnar side, fingers strongly flexed, nails in the palms of the hands. The thumbs, though drawn in, may be used. The knees are generally crossed. The general health through it all may be fair, as visceral lesions are uncommon.

In the monarticular or localized type, the disease is usually confined to one or two of the larger joints, occurs mostly in men, and after 50. The knee, shoulder, elbow, or hip is generally affected, but the vertebræ may be, the entire spinal column becoming rigid. Motion of affected joints often produces a creaking or grating sound. The pathological appearances are similar to those of the general type of the disease, but joint-injuries are more often an exciting cause. The joint becomes stiff, sore, and painful, and there is absorption of the ends of the bones, dislocation, and deformity.

Heberden's nodes or nodosities, described by him in 1805, are small exostoses («small hard knobs»), seldom larger than peas, which form on either side of the distal joints of fingers. They may be present in either type of the disease, at first are tender and swollen, but later on apparently cause little discomfort. Sometimes the bone-enlargement surrounds the joint.

Arthritis deformans in children, although not frequent, is more acute, and is more influenced by poor food, cold and damp, etc. There is fever, sometimes a chill. The swelling, stiffness, and tenderness seem to be more in the soft parts than in harder tissues. The fingers are flexed and overlapped, the feet are strongly extended, and the joints are rigid.

The diagnosis of arthritis deformans must be made from subacute and chronic rheumatism, gonorrhœal rheumatism, gout, progressive muscular atrophy, Charcot's disease, etc. Recovery is impossible, but the disease is not directly dangerous to life. Treatment for relief is hygienic and dietetic, a warm, dry, equable climate, dry, healthful quarters, change of scene, freedom from anxiety, shock, etc., woolen underclothes, flannel nightgowns or pajamas, and ample diet. Malt extracts, iron, and cod-liver oil are of service. Locally there should be application of massage, friction, electricity, douching, hot air in so-called hot-box, guiacol and glycerine in equal parts, or belladonna ointment, cotton, and oil-silk. Residence at one of the spas, with appropriate care and treatment, will relieve suffering and prolong life. See ARTHRITIS; GOUT; JOINT; RHEUMATISM.

Arthrocace (Neo.-Lat. from Gk. ἄρθρον, joint + κακή, evil), a disease of the joints in which the bone is disintegrated and carried away piecemeal. See CARIES.

Arthro'dia. See JOINT.

Arthrodynia (Neo.-Lat. from Gk. ἄρθρον, joint + ὀδύνη, pain), pain in a joint; practically synonymous with arthralgia.

Arthrogastra (Neo.-Lat. from Gk. ἄρθρον, joint + γαστήρ, abdomen), a division of the insect class Arachnida (q.v.), having the abdomen annulated, and including the scorpions (see SCORPION), etc.

Arthromere (Gk. ἄρθρον, joint + μέρος, part), one of the series of segments of which arthropoda (q.v.) are composed.

Arthropathia Tabidorum, a disease of the joints in connection with spinal disease (*tabes dorsalis*), very similar to *arthritis deformans* (q.v.). The destruction of the ends of the bones in the joint concerned takes place with great rapidity and painlessly; there is no fever nor appearance of inflammation, even when the bones are fractured.

Arthrophragm (Gk. ἄρθρον, joint + φράγμα, fence), a partition between certain articulations, as, for example, in the crayfish (q.v.).

Arthropleure (Neo.-Lat. *Arthropleura*, from Gk. ἄρθρον, joint + πλευρά, side), the lateral portions of the arthroderm, or crust, of articulated animals. See ARTICULATA.

Arthrop'oda, a phylum comprising those articulated animals which have jointed appendages, such as antennæ, jaws, maxillæ (or accessory jaws), palpi, and legs, arranged in pairs, the two halves of the body thus being more markedly symmetrical than in the lower animals. It is by far the most numerous in species of any in the animal kingdom, the insects alone probably numbering upward of a million species; other representative or typical forms are the trilobites, king crabs, scorpions, spiders, and myriopods. The skin is usually hardened by the deposition of salts (carbonate and phosphate of lime), and of a peculiar organic substance called chitine. The segments (somites or arthromeres) composing the body are usually limited in number, 20 (or 21) in the crustaceans and insects; while each arthromere is primarily divided into an upper (tergum), lower (sternum), and lateral portion (pleurum). These divisions, however, cannot be traced in the head of either the crustaceans or the insects. Moreover, the head is well marked, with one or two pairs of feelers or antennæ, and from two to four pairs of biting mouth-parts or jaws, and two compound eyes; besides the compound eyes there are simple eyes in the insects. The germ is three-layered, and there is usually in the more specialized forms a well-marked metamorphosis. The *Arthropoda* are most nearly related to the worms, certain annelides, with their soft-jointed appendages (tentacles as well as lateral cirri) and more or less definite head, anticipating or foreshadowing the arthropods. On the other hand, certain low parasitic arthropods, as linguatula, have been mistaken for genuine parasitic worms.

Segmentation of the Body.— The segments (somites, metameres) are merely thickenings of the skin connected by a thin intersegmental membrane, so that the segments can telescope into each other, or extend, thus lending the greatest freedom of motion to the trunk as well as to the appendages; otherwise a rigid chitinous skin would not permit of any movement. As in the annelid worms, this segmentation of the integument is correlated with the serial repetition of the ganglia of the nervous system, of the ostia of the dorsal vessel, the primitive disposition of the segmental and reproductive organs, of the soft, muscular dissepiments which correspond to the suture between the segments, and with the metameric arrangement of the muscles controlling the movements of the segments on each other; and this internal segmentation or metamerism is indicated very early in embryonic life by the mesoblastic somites.

While we look upon the dermal tube of worms as a single but flexible lever, the body of the arthropods, as Graber states, is a linear system of stiff levers. We have here a series of stiff, solid rings, or hoops, united by the intersegmental membrane into a whole. When the muscles extending from one ring to the next behind contract, and so on through the entire series, the rings approximate each other.

The origin of the joints or segments in the limbs of arthropods was probably due to the mechanical strains to which what were at first soft fleshy outgrowths along the sides of the body became subjected. Indeed, certain annelid worms of the family *Syllidæ* have segmented tentacles and parapodia, as in Dujardinia. We do not know enough about the habits of these worms to understand how this metamerism may have arisen, but it is possibly due to the act of pushing or repeated efforts to support the body while creeping over the bottom among broken shells, over coarse gravel, or among sea-weeds. It is obvious, however, that the jointed structure of the limbs of arthropods, if we are to attempt any explanation at all, was primarily due mainly to lateral strains and impacts resulting from the primitive endeavors of the ancestral arthropods to raise and to support the body while thus raised, and then to push or drag it forward by means of the soft, partially jointed, lateral limbs which were armed with bristles, hooks, or finally claws. By adaptation, or as the result of parasitism and consequent lack of active motion, the original number of segments may by disuse be diminished. Thus in adult wasps and bees, the last three or four abdominal segments may be nearly lost, though the larval number is ten. During metamorphosis the body is made over, and the number, shape, and structure of the segments are greatly modified.

History and Present Classification.— The group or sub-kingdom (phylum) of *Arthropoda* was founded in 1848 by Siebold. It has been supposed until recently to be a natural group. In 1893 Kingsley, and also Kennel, first suggested doubts as to the homogeneity of the group, and in the same year Packard published the view that there are four independent lines of development in the *Arthropoda*, and in 1894 Kingsley divided the group into three subphyla, Laurie and Pocock also considering that the group is polyphyletic. In 1898 Packard stated: "It is becoming evident, however, that there was no common ancestor of the *Arthropoda* as a whole, and that the group is a polyphyletic one.

Hence, though a convenient group, it is a somewhat artificial one, and may eventually be dismembered into at least three or four phyla or branches.»

The four phyla as afterward proposed by Packard are, beginning with the most primitive: (1) *Palæostraca,* embracing the classes of *Trilobita;* (2) *Merostomata* (*Limulus*), and *Arachnida;* (3) *Pancarida* (*Crustacea*); (4) *Prosogoneata,* including three classes: *Pauropoda, Diplopoda,* and *Lymphyla* (*Scolopendrella*); and (5) *Entomoptera,* comprising the *Chilopoda* and *Insecta;* the great majority of the group being winged insects. Each of these phyla represent independent lines of development, judging by their structure and what we know of their development, and have no genetic connection beyond the theory that they each have descended from one or more annelid worms.

A. S. PACKARD,
Late Prof. Zoology, Brown University.

Arthrostraca, crustacea of the sub-class *Malacostraca* in which the first, sometimes the second thoracic segment is fused with the head and bears maxillipedes; the remaining seven being free and bearing legs. The eyes are usually sessile. The group is divided into the *Amphipoda* (q.v.) and *Isopoda* (q.v.). Common examples are pill-bug, wood-louse, etc.

Ar'thur, king of the Silures in the 6th century, an ancient British hero, whose story has been the theme of much romantic fiction. He is said to have been the son of Uthyr, chief commander of the Britons, and to have been born about 501. In 516 he succeeded his father in the office of general, and performed those heroic deeds against the Saxons, Scots, and Picts which have made him so celebrated. He married the celebrated Guinevere belonging to the family of the dukes of Cornwall; established the famous order of the Round Table; and reigned, surrounded by a splendid court, 12 years in peace. After this, he is reported to have conquered Denmark, Norway, and France, slain the giants of Spain, and journeyed to Rome. From thence he is said to have hastened home on account of the faithlessness of his wife, and Modred, his nephew, who carried on an adulterous intercourse, and stirred up his subjects to rebellion; to have subdued the rebels, but to have died in consequence of his wounds, in 542, on the island of Avalon, where it is pretended that his grave was found in the reign of Henry II. The story of Arthur is supposed to have some foundation in fact, and it is generally believed that he was one of the last great Celtic chiefs who led his countrymen from the west to resist the settlement of the Saxons in southern Britain. But many authorities regard him as a leader of the Cymry of Cumbria and Strath-Clyde against the Anglo-Saxon invaders of the east coast and the Picts and Scots north of the Forth and the Clyde. In our own day the interest of the old legends has been revived by the works of Lytton and especially Tennyson. See Skene, 'Four Ancient Books of Wales' (1868); Stuart-Glennie, 'Journey through Arthurian Scotland' (1867); and 'Arthurian Localities' (1869); Rhys, 'Studies in the Arthurian Legend' (1891); Sommer, 'Morte d'Arthur' (3 vols. 1889–91); Brown, 'Twain: A Study in the Origin of Arthurian Romance' (1902). See ARTHURIAN LEGENDS.

Ar'thur, Prince. See DUKE OF CONNAUGHT.

Ar'thur, duke of Brittany, the grandson of King Henry II. of England: b. 1187; d. 1203. On the death in 1199 of his uncle, Richard I., who had declared the boy his heir, Arthur was proclaimed king of England by the nobles of Anjou, Touraine, and Maine, while the English lords decided in John's favor. King Philip of France supported the claims of Arthur, but a peace being presently concluded between John and Philip, Arthur came later into the hands of his uncle, King John, and soon mysteriously disappeared. According to general belief Arthur was murdered by command of his uncle. The story of Arthur forms a portion of Shakespeare's 'King John.' See JOHN.

Arthur, Chester Alan, the 21st President of the United States: b. Fairfield, Vt., 5 Oct. 1830; d. New York, 18 Nov. 1886. He graduated from Union College at 18, was principal of an academy at North Pownal, Vt., and in 1853 began the practice of law in New York, where he argued several important legal cases in behalf of the colored people. Through these and other cases he became noted in his profession, and he was also prominent as a Republican politician. In April 1861 Gov. E. D. Morgan made him acting quartermaster-general, and later he was made full quartermaster-general. For the next decade he was a successful and widely known practising lawyer, and a leading Republican politician of New York, chairman of the Grant Club in 1868, and of the executive committee of the Republican State committee in 1869. He was appointed by President Grant, 20 Nov. 1871 to the highest office in the State patronage, the collectorship of the port of New York, which he held till 11 July 1878. His business conduct of the office was not impeached, and he was retained by President Hayes for over a year after his accession; but he was first of all a political manager, in open hostility to civil service reform. As a matter of actual practice and not theory, however, Mr. Arthur produced figures to show that the annual percentage of removals under him for all causes had been only 2¾ per cent, as against an annual average of 24 per cent since 1857. In 1880 he was nominated for the vice-presidency, chiefly to conciliate the Grant section of the Republicans, sore at the defeat of the third-term project, and was elected with Garfield. In place of the customary dignified nullity of his office, he remained an active party leader in the patronage contest of his State, between the «Stalwarts» or Grant section led by Roscoe Conkling (q.v.), and of which Mr. Arthur was chief lieutenant, and the «Half-Breeds» or more independent wing which Garfield was trying to build up. Conkling soon resigned his seat in the Senate, declaring that Garfield had broken his promises to him, and the Garfield party for the time was triumphant; but the assassination of Garfield, shortly after, reversed the situation. The open lamentations of the press at the prospect of the accession of so convinced a spoilsman as himself deeply hurt Mr. Arthur, who felt that he was misjudged, and determined on the most admirable revenge, that of disappointing their prophecies of evil. He did so; not only was his term of office measurably free from the dominance of patronage, but he extended the civil service rules and kept faith with them. In other respects his ad-

CHESTER ALAN ARTHUR.

21ST PRESIDENT OF THE UNITED STATES.

ministration was so excellent that the leading Independents had announced their intention of supporting him for President if nominated in 1884. Its most notable incident was the appointment of a commission to revise the tariff, which, though composed of strong Protectionists, reported that the tariff should be reduced 20 per cent all around, a recommendation unheeded by Congress. Several commercial treaties were passed, however. He vetoed a Chinese immigration bill as inconsistent with treaty obligations; favored the stringent laws passed against polygamy, appointing a Utah commission to supervise their enforcement; managed Indian affairs wisely, promoting Indian education and the breaking up of the tribal system; extended postal facilities; took measures to increase the navy, improve its discipline and efficiency and provide for coast defense; supported the improvement of Mississippi River navigation, etc. The attempts at remonetizing silver, and at forcibly abrogating the Clayton-Bulwer treaty to build a Nicaragua canal, were in accordance with general party feeling at the time. The lingering scandal of the Star Route frauds, however, injured the party somewhat, and its policy and methods were gravely disapproved of by the Independents; but this was much more than counterbalanced by distrust of the Democratic party for its alliance with the Greenback element. Mr. Arthur's defeat for the nomination was not caused by any demerits of his own, still less by desire to conciliate the Independents, but by the personal ambitions of Republican leaders, which, justly or unjustly, had aroused and exasperated the Republicans of the State of New York, causing the defeat of C. J. Folger for Governor, and resulting in the nomination of Blaine in 1884. Arthur, although a close adherent of Conkling, supported Blaine.

Ar'thur, Joseph Charles, an American botanist: b. Lowville, N. Y., 11 Jan. 1850. He was graduated from Iowa State College in 1872, and subsequently studied at the universities of Johns Hopkins, Harvard, and Bonn, Germany. He was instructor in the universities of Minnesota and Wisconsin; botanist at the Experiment Station, Geneva, N. Y., and is now professor of vegetable physiology and pathology, Purdue University, Lafayette, Ind.

Arthur, Julia, the stage name of Ida Lewis, an American actress: b. Hamilton, Ont., 3 May 1869. She made her professional début at the age of 14 as the Prince of Wales in 'Richard III.' Her first New York success was in 'The Black Masque.' She made her London début February 1895 in Henry Irving's company, playing roles next to Helen Terry, both of whom she accompanied to America in 1896. Since then she has starred chiefly in the United States. She is the wife of B. P. Cheney. See Strang, 'Famous Actresses of the Day in America' (1899).

Arthur, P. M., American locomotive engineer: b. Scotland 1834; d. Winnipeg, Manitoba, 16 July 1903. He came to America in childhood and as a young man was at first a blacksmith's helper in the employ of the New York and Harlem Railroad Company and later an engineer on the New York Central railroad. In 1873 he became the grand chief of the American Brotherhood of Locomotive Engineers, which post he filled at the time of his death.

Ar'thur, Timothy Shay, an American author: b. Newburg, N. Y., 1809; d. Philadelphia, 6 March 1885. In 1852 he founded 'Arthur's Home Magazine.' He was a voluminous writer of moral and domestic tales. His works are over 100 in number, and have had a large sale in England as well as in the United States. His most popular work was the famous 'Ten Nights in a Bar-Room.' Among his other publications were 'Tales for Rich and Poor,' 'Tales of Married Life,' and 'Lights and Shadows.'

Arthu'rian Leg'ends, a series of Celtic romances, which for nearly a thousand years have furnished unlimited literary material, not to English poets alone, but to the poets of all Christendom. These Celtic romances, having their birthplace in Brittany or in Wales, had been growing and changing for some centuries, before the fanciful 'Historia Britonum' of Geoffrey of Monmouth, flushed them with color and filled them with new life. Through his version they soon became a vehicle for the dissemination of Christian doctrine. By the year 1200 they were the common property of Europe, influencing profoundly the literature of the Middle Ages, and becoming the source of a great stream of poetry that has flowed without interruption down to our own day. Sixty years after the 'Historia Britonum' appeared, and when the English poet Layamon wrote his 'Brut' (A.D. 1205), a translation of Wace, as Wace was a translation of Geoffrey, the theme was engrossing the imagination of Europe. It had absorbed into itself the elements of other cycles of legend, which had grown up independently; some of these, in fact, having been at one time of much greater prominence. Finally, so vast and complicated did the body of Arthurian legend become, that summaries of the essential features were attempted. Such a summary was made in French about 1270, by the Italian Rustighello of Pisa; in German, about two centuries later, by Ulrich Füterer; and in English by Sir Thomas Malory in his 'Morte d'Arthur,' finished 'the ix. yere of the reygne of kyng Edward the Fourth," and one of the first books published in England by Caxton, "emprynted and fynysshed in th' abbey Westmestre the last day of July, the yere of our Lord MCCCCLXXXV." It is of interest to note, as an indication of the popularity of the Arthurian legends, that Caxton printed the 'Morte d'Arthur' eight years before he printed any portion of the English Bible, and 53 years before the complete English Bible was in print. It has been said that the original legend absorbed into itself the elements of other cycles of legend. The most important of these was 'The Holy Grail' (q.v.). At once a new spirit breathes in the old legend. In a few years it is become a mystical, symbolical, anagogical tale, inculcating one of the profoundest dogmas of the Holy Catholic Church, a bearer of a Christian doctrine engrossing the thought of the Christian world. In addition to the mystical and religious character of the transformed legend, the spirit of the chivalry of the Middle Ages embodied in it, furnishes an admirable transcript of the social ideal of the times, which thus moulded the older and ruder materials into a more gracious form. The knightly ideals of loyalty, obedience, the redressing of wrongs and especially the veneration of womanhood are distinctively portrayed.

Throughout the Middle Ages it was «our lady,» the Virgin Mother, who embodied and represented to all men and women, from prince to peasant, their ideals of womanhood and ladyhood. And it was the transference of these Christian ethics into the practice of common daily, worldly life, in rude times, which we owe to the institution of chivalry, nowhere better reflected than in the Christianized Arthurian legends. From about 1200, innumerable poets, with diverse tastes, set themselves to produce new versions of the legend, engrafting upon the general theme many diverse stocks. Dante in the ‹Divine Comedy› speaks of Arthur, Guinevere, Tristan, and Launcelot by name, and Boiardo, Ariosto, and Tasso in Italy, Hans Sach in Germany, Spenser, Shakespeare, Milton, and Dryden in England, all made use of the same material.

Of the poets of the present generation, Tennyson has treated the Arthurian poetic heritage as a whole. Phases of the Arthurian theme have been presented also by his contemporaries and successors at home and abroad — by William Wadsworth, Lord Lytton, Robert Stephen Hawker, Matthew Arnold, William Morris, Algernon Charles Swinburne, in England; Edgar Quinet in France; Wilhelm Hertz, L. Schneegans, F. Roeber, in Germany; Richard Hovey in America. There have been many other approved variations on Arthurian themes, such as James Russell Lowell's ‘Vision of Sir Launfal,’ and Richard Wagner's operas, ‘Lohengrin,’ ‘Tristan and Isolde,’ and ‘Parsifal.’ Of still later versions, we may mention the ‘King Arthur’ of J. Comyns Carr, which has been presented on the stage by Sir Henry Irving; and ‘Under King Constantine,’ by Katrina Trask, whose hero is the king whom tradition names as the successor of the heroic Arthur "Imperator Dux Bellorum."

Ar'thur's Seat, a hill overlooking Edinburgh, Scotland, said to have been so called from a tradition that King Arthur surveyed the country from its summit and defeated the Saxons in its neighborhood. It is a steep, and in some places precipitous, rock, exhibiting on the south side a range of perpendicular basaltic columns, called Samson's Ribs. The highest point is 822 feet above sea-level. From hence may be seen a wide expanse of sea, the course of the Forth, the distant Grampians, etc., and a large portion of the most populous and best cultivated part of Scotland, including the picturesque city of Edinburgh and its castle. On the north side are the ruins of a chapel and hermitage, dedicated to St. Anthony, and a fine spring called St. Anton's Well. A carriage road called the Queen's Drive goes round its base.

Ar'tichoke, two species of the natural order *Compositæ.* The true, sometimes called French, artichoke (*Cynnara Carduncculus* — scalymus of some authors), a native of the Mediterranean region, is a coarse, stout, perennial, thistle-like herb, 3 to 5 feet tall, with rather spiny leaves, the lower of which are often 3 feet or more long, and large terminal heads of blue or white flowers. It is cultivated for the edible thickened outer scales and «bottoms» (receptacles) of the flower heads which sometimes exceed 4 inches in diameter without becoming too old for eating raw as salad, pickled, or cooked like cauliflower. Sometimes the young stems and leaves are blanched like cardoon, with which some botanists consider it to be identical. In Europe many varieties are popular; in America the globe variety is planted almost to the exclusion of others, with the result that this variety has almost become united to the name in popular usage. The cultivation of this species in America is confined mostly to the southern States, few gardens in the North being supplied with it. Since the plant is rather tender, winter protection must be given where the ground freezes. If planted in rich soil and set four feet apart the plants will yield two or three crops before a new plantation should be made; if allowed to stand longer the yield gradually diminishes. New plantations are made either with seedling or sucker plants. Most of the artichokes offered in the northern markets of the United States come from France and Louisiana.

The Jerusalem artichoke (*Helianthus tuberosus*), a native of North America, is a perennial sunflower-like herb, 5 to 12 feet tall, with rough leaves 4 to 8 inches long and many yellow terminal flower-heads often 2 to 3 inches in diameter. The edible pear-shaped purplish, red, white, or yellow tubers for which the plant is often cultivated are numerous, seldom more than 3 inches in diameter, rather watery but of pleasant flavor especially when prepared like cauliflower, with a white sauce. Perhaps no vegetable is of easier cultivation. For home use the tubers are generally planted in well-drained soil in some out of the way corner of the garden and allowed to take care of themselves from year to year, the few tubers and pieces of root left after digging sufficing to re-stock the bed. In field culture the methods are like those practised with the potato except that the tubers may be left in the ground over winter and dug when needed. They are not injured by frost if in the soil, but if frozen after being dug they spoil quickly. If desired they may be dug and stored in pits like turnips, but with a somewhat lighter covering of straw and earth. The usual yield is from 200 to 500 bushels to the acre but 1,000 bushels are sometimes obtained. When land becomes infested, as it sometimes does, with the plant, pigs, for which the tubers make valuable food, may be turned loose upon the field. The tubers resemble potatoes in composition and like them are used largely in Europe for the manufacture of alcohol. The young plants are sometimes used as cattle food and the dry stalks for fuel. Consult ‘Bur or Globe Artichoke’ in United States Department of Agriculture Year Book, 1899; Circular 31 (1899); Bailey, ‘Cyclopædia of American Horticulture’ (1900–02); Vilmorin, ‘The Vegetable Garden,’ translation by Robinson (1885).

Ar'ticle, in grammar, a part of speech used before nouns to limit or define their application. In the English language *a* or *an* is the indefinite article (the latter form being used before a vowel sound) and *the* the definite article. The English indefinite article is really a modified form of the numeral adjective *one;* so the German *ein* and the French *un* stand for the numeral and the article. There are traces in various languages showing that the definite article was originally a pronoun; thus the English *the* is closely akin to both *this* and *that.* The Latin language has neither the definite nor the indefinite article; the Greek has the definite; the

Hebrew and Arabic definite article was prefixed to its noun, while, on the other hand, in the Syriac and Chaldaic it was affixed to the noun, as it is in the Icelandic. In the Scandinavian language the definite article is appended to the end of the word as *hus-et,* the house.

Ar'ticles, divisions of a printed or written document or agreement. A specification of distinct matters agreed upon or established by authority or requiring judicial action. In chancery practice articles are a formal written statement of objections to the credibility of witnesses in a cause in chancery, filed by a party to the proceedings, after the depositions have been taken and published. The object of articles is to enable the party filing them to introduce evidence to discredit the witnesses to whom the objections apply, where it is too late to do so in any other manner (2 Daniel Chan. Pr. 1158), and to notify the party whose witnesses are objected to of the nature of the objections, that he may be prepared to meet them. Upon filing the articles a special order is obtained to take evidence. The interrogatories must be so shaped as not to call for evidence which applies directly to facts in issue in the case. 3 Johns. Ch. N. Y. 558. The objections can be taken only to the credit and not to the competency of the witnesses. 3 Johns. Ch. N. Y. 558; 3 Atk. Ch. 643, and the court are to hear all the evidence read and judge of its value. 2 Ves. Ch. 219.

Articles of Agreement.— A written memorandum of the terms of an agreement. They may relate either to real or personal estate, or both, and if in proper form will create an equitable estate or trust such that a specific performance may be had in equity. The articles of agreement should contain a clear and explicit statement of the names of the parties, with their additions for purposes of distinction, as well as a designation as parties of the first, second, etc., part; the subject-matter of the contract, including the time, place, and more important details of the manner of performance; the covenants to be performed by each party; the date, which should be truly stated. It should be signed by the parties or their agents. When signed by an agent the proper form is, A. B., by his agent(or attorney), C. D.

Articles of Confederation.— The title of the compact which was made by the 13 original States of the United States of America. It was adopted and carried into force 1 March 1781 and remained as the supreme law until the first Wednesday of March 1789.

Articles of Faith.— Summarized statements of religious views relating to the central doctrines of a theological system. Protestant divines divide these into fundamental and non-fundamental articles. Familiar examples of articles of faith are the Nicene, Apostles', and Athanaisan creeds, the Thirty-Nine Articles, the Westminster, Augsburg, and Helvetic Confessions. See CREED.

Articles of Impeachment.— A written articulate allegation of the causes for impeachment. Blackstone calls them a kind of bill of indictment, and they perform the same office which an indictment does in a common criminal case. They do not usually pursue the strict form and accuracy of an indictment, but are sometimes quite general in the form of their allegations. They should, however, contain so much certainty as to enable a party to put himself on the proper defense, and in case of an acquittal to avail himself of it as a bar to another impeachment. Additional articles may perhaps be exhibited at any stage of the proceedings. The answer to articles of impeachment is exempted from observing great strictness of form, and it may contain arguments as well as facts. A full and particular answer to each article of the accusation should be given.

Articles of Partnership.— A written agreement by which the parties enter into a partnership upon the conditions therein mentioned. The instrument should contain the names of the contracting parties severally set out; the agreement that the parties do by the instrument enter into a partnership, expressed in such terms as to distinguish from a covenant to enter into a partnership at a subsequent time; the date and necessary stipulations, some of the more common of which follow. The commencement of the partnership should be expressly provided for. The date of the articles is the time, when no other time is fixed by them. The duration of the partnership should be expressly stated. It may be for life, for a limited period of time, or for a limited number of adventures. When a term is fixed it is presumed to endure until that period has elapsed, and when no term is fixed, for the life of the parties, unless sooner dissolved by the acts of one of them, by mutual consent, or operation of law. The duration will not be presumed to be beyond the life of all the partners, but provision may be made in the articles for the succession of the executors or administrators or a child or children of a deceased partner to his place and rights. Where provision is made for a succession by appointment and the partner dies without appointing, his executor or administrators may continue the partnership or not at their option. A continuance of the partnership beyond the period fixed for its termination, in the absence of circumstances showing intent, will be implied to be upon the basis of the old articles (15 Ves. Ch. 218), but for an indefinite time. The nature of the business and the place of carrying it on should be carefully stated. An injunction will be granted by a court of equity when one or more of the partners endeavors, against the wishes of one or more of them, to extend such business beyond the provision contained in the articles. The name of the firm should be ascertained. The members of the partnership are required to use the name thus agreed upon, and a departure from it will make them individually liable to third persons or to their partners in individual cases. The management of the business, or of some particular branch of it, is frequently entrusted by stipulation to one partner, and such partner will be protected in his rights by equity, or it may be to a majority of the partners, and should be where they are numerous. The manner of furnishing capital and stock should be provided for. When a partner agrees to furnish his proportion of the stock at stated periods, or pay by installments, he will, where there are no stipulations to the contrary, be considered a debtor to the firm. Sometimes a provision is inserted that real estate and fixtures belonging to the firm shall be considered as between the partners, not as partnership, but as individual property. In cases of bankruptcy, this property will be treated

as the separate property of the partners. The apportionment of profits and losses should be provided for. The law distributes these equally, in the absence of controlling circumstances, without regard to the capital furnished by each. Periodical accounts of the property of the partnership may be stipulated for. These, when settled, are at least *prima facie* evidence of the facts they contain. The expulsion of a partner for gross misconduct, bankruptcy, or other specified causes may be provided for, and the provision will govern when the case occurs. A settlement of the affairs of the partnership should always be provided for. It is generally accomplished in one of the three following ways: *First*, by turning all of the assets into cash, and after paying all the liabilities of the partnership, dividing such money in proportion to the several interests of the parties; or, *second*, by providing that one or more of the partners shall be entitled to purchase the shares of the others at a valuation; or, *third*, that all the property of the partnership shall be appraised, and that after paying the partnership debts it shall be divided in the proper proportions. The first of these modes is adopted by courts of equity in the absence of express stipulations. Submission of disputes to arbitration is frequently provided for, but such a clause is nugatory, as no action will lie for a breach.

Articles of War.— A code of laws for the regulation of the military forces of a country. In the United States the articles of war form an elaborate code, thoroughly revised in 1880, but subject at all times to the legislation of Congress. Those of Great Britain and Ireland were issued prior to 1879, in pursuance of the annually renewed mutiny act. In 1879 the army discipline act consolidated the provisions of the mutiny act with the articles of war. This act was amended in 1881, and now the complete military code is contained in the army act of 1881.

Ar'ticles, The Six. In English Church history these were articles of faith imposed by the Act 31 Henry VIII. cap. xiv., passed by Parliament in 1539, and known as the Six-stringed Whip or Bloody Statute, from the merciless persecutions to which it gave rise. They are supposed to have been the composition of King Henry himself, and they had no formal authority from the Church. They enforced belief in transubstantiation; declared communion in both kinds unnecessary; the marriage of priests was unlawful; that vows of chastity or widowhood were absolutely binding; and that private masses and auricular confession were expedient and necessary. The severity of the act was soon mitigated, and it was finally repealed in the first year of Edward VI.

Ar'ticles, The Thirty-nine, of the Church of England, a term applied to a body of divinity, chiefly founded on the formulary of Forty-two Articles compiled by Archbishop Cranmer in 1551, in obedience to the command of Edward VI. and the privy council, who instructed him to "frame a book of articles of religion, for the preserving and maintaining peace and unity of doctrine in this Church, that, being finished, they might be set forth by public authority." Several of these articles (the 1st, 2d, 25th, and 31st) were drawn directly from the Augsburg Confession, and the 9th and 16th are traceable to the same source. During the reign of Mary the Articles were suppressed, but the accession of Elizabeth offered an opportunity of drawing up a fresh formulary. In 1562–3 a convocation was held, in the course of whose sitting King Edward's Articles were carefully considered and revised. As the result of this revision (mainly the work of Archbishop Parker, assisted by Bishops Grindal, Horn, and Fox), four of the original 42 articles were omitted, namely, the 10th, 16th, 19th, and 41st, and articles 5th, 12th, 29th, and 30th were newly introduced; 17 other articles were more or less modified. On a further revision articles 39th, 40th, and 42d were struck out, and some slight changes made in several others. These 39 articles were drawn up and ratified in Latin, but when printed both in Latin and English the 29th was omitted and the first clause of the 20th struck out. The 39th was, however, restored on a final revision by Parker in 1571, and then imposed on the clergy for subscription. They were ratified anew in 1604 and 1628. All candidates for ordination must subscribe these articles, but subscription is no longer necessary on matriculating or taking a degree at Oxford or Cambridge. This formulary is now accepted by the Episcopalian Churches of Scotland, Ireland, and America.

The first five articles contain a profession of faith in the Trinity, the incarnation of Jesus Christ, his descent to hell, and his resurrection, and the divinity of the Holy Ghost. The three following relate to the canon of the Scripture. The 8th article declares a belief in the Apostles', Nicene, and Athanasian creeds. The 9th and following articles contain the doctrine of original sin, of justification by faith alone, of predestination, etc. The 19th, 20th, and 21st declare the Church to be the assembly of the faithful, and that it can decide nothing except by the Scriptures. The 22d rejects the doctrine of purgatory, indulgences, the adoration of images, and the invocation of saints. The 23d decides that only those lawfully called shall preach or administer the sacraments. The 24th requires the liturgy to be in English. The 25th and 26th declare the sacraments effectual signs of grace (though administered by evil men), by which God excites and confirms our faith. They are two: baptism and the Lord's Supper. Baptism, according to the 27th article, is a sign of regeneration, the seal of our adoption, by which faith is confirmed and grace increased. In the Lord's Supper, according to article 28th, the bread is the communion of the body of Christ, the wine the communion of his blood, but only through faith (article 29); and the communion must be administered in both kinds (article 30). The 28th article condemns the doctrine of transubstantiation, and the elevation and adoration of the Host; the 31st rejects the sacrifice of the mass as blasphemous; the 32d permits the marriage of the clergy; the 33d maintains the efficacy of excommunication. The remaining articles relate to the supremacy of the king, the condemnation of Anabaptists, etc.

Artic'ula'ta, a name given by Cuvier to a branch of the animal kingdom embracing the worms (*Annulata*) and *Arthropoda*. The group is not now considered a natural one, and has been subdivided into several branches or phyla.

Ar'ticula'tion. See JOINT.

Artificial Camphor, a product manufactured from turpentine. The sap of the pine tree after it is distilled and purified is the turpentine of commerce. A couple of thousand pounds of this material is placed in great steam reaction tanks; these are covered with asbestos to retain the heat. A quantity of oxalic acid, which is rich in oxygen, is likewise placed in the reaction tanks, together with the turpentine, and when the chemical action resulting from the union has been completed two new chemicals are formed and are known as pinol oxalate and pinol formate, respectively. These are in liquid form and are conveyed to a set of distilling tanks by means of a force pump; in these tanks a new element is introduced in the form of an alkali, and when mixed with the liquid live steam is turned on. After distillation camphor results, together with some of the essential oils, such as oil of lemon and others, but these are dissolved in the reaction products, which also contain a kind of camphor termed borneol.

Ar'tifi'cial Flow'ers, flowers manufactured from cloth or other substances in close imitation of natural flowers, for purposes of ornament. The leaves and petals are generally made of silk or cambric punched out to proper shapes and sizes. These are tinted with a brush and color, and if necessary glazed with gum or sprinkled with fine flock to imitate the glossy or velvety surface of natural flowers. The ribs, where present, are indented with a warm iron. The stamens and pistils are formed of wire covered with silk and dipped in gum-water to form the anthers. The stalk is then made of wire, coated with green paper, and fixed to the stamens and pistil, around which are attached the petals, and lastly the calyx. Buds are made of cotton or glass balls covered with cambric of a proper color. This industry has been successfully carried on in the United States, where a large number of women are constantly employed in making artificial flowers. The coloring matter, however, used for these articles is often nothing less than the deadly poison arsenic. Hoffman and other chemists have shown that the most terrible effects may spring from the use of these arsenical compounds.

Ar'tifi'cial Limbs, substitutes for human arms and legs and parts thereof, the manufacture of which has received the attention of surgeons and mechanics from a very early date. In the great work on surgery by Ambrose Paré, in 1579, he refers to and gives detailed illustrations of an artificial arm and leg, and although the construction was of a rude character they showed a very good attempt to conceal the mutilation. In 1696 an artificial leg was invented by Verduin, a Dutch surgeon. It was composed of a wooden foot, to which was fastened two strips of steel extending up to the knee. To these strips was riveted a copper socket to receive the stump; a leather for lacing around the thigh was connected to the socket by two steel side-joints, thus dividing the points of support between the thigh and stump. The construction of this leg was improved later by Prof. Serre of Montpelier. Improvements and new limbs were more recently introduced into England and France by Fred. Martin, M. Charrière, MM. Mathieu and Bechard, but these were mostly unprotected by patents. Thomas Mann secured patents for artificial limbs 20 Jan. 1790, and 1810. James Potts of England patented a new leg 15 Nov. 1800. This soon became celebrated as the «Anglesea leg,» because it was so long worn by the Marquis of Anglesea. An improvement on this leg was patented by William Selpho, who was the first manufacturer of note in New York, where he established himself in 1839. Other inventors and manufacturers soon took a great interest in the business — so many, in fact, that the American patent office shows a record of about 150 patents on artificial legs, or more than double that of all European patents on limbs. The Civil War, which caused the mutilation of so many soldiers and sailors, and the liberality of the government in supplying their losses with artificial limbs, naturally stimulated the efforts of inventors in producing such substitutes as would be accepted. These soldiers and sailors are supplied once in every five years, and to this demand is added that of those who have lost limbs from disease or accident, making in all about 100,000 in the United States who have to be supplied with new limbs on an average of about once in every five to eight years. The perfection to which limbs have been brought is wonderful and very interesting. A person with two artificial legs can walk so perfectly as to avoid detection, and a person with a single amputation can almost defy detection. Notable improvements in artificial limbs, and more particularly in legs, were made by C. A. Frees of New York. One of these improvements, and one of the most important, consists in the movements of the knee and ankle joints, by which the whole limb is strengthened and made more durable. An important feature of this piece of mechanism consists in the introduction of a universal motion at the ankle-joint, imitating the astragalus movement with an additional joint, and thus producing a most perfect artificial substitute. Another of his improvements of equal importance, is in the knee-joint of the leg for thigh amputation, which is so arranged that when in a sitting position the cord and spring are entirely relaxed, relieving all strain and pressure; and when rising to an upright position the cord and spring are again brought into proper position without strain or unnatural movement, no extra attachments being required. Artificial arms and extension apparatus for short legs are also wonderful examples of American ingenuity.

Ar'tifi'cial Respira'tion. See ASPHYXIA; DROWNING (*Treatment*); RESPIRATION.

Artificial Stone, a combination of hydraulic cement, broken stone, sand, etc., cemented together. There are many varieties, some of which are exceedingly valuable for building purposes, especially in localities where building-stone is not readily obtained. Cements thus made increase in strength and solidity for an indefinite period. This stone is in constantly increasing demand. For the various kinds and uses see CEMENT.

Artigas, är-tē'gas, **Fernando José,** a South American soldier, dictator of Uruguay: b. Montevideo, 1755; d. in 1851. In 1811 he joined the revolt of Buenos Ayres against Spain, whose troops he repeatedly defeated; but acting for himself was outlawed by the insurrectionary junta, whose troops in turn he routed and compelled it to cede Uruguay to him in 1814. He then assumed the dictatorship, but in 1820 was

defeated and fled to Paraguay, where the dictator Francia banished him to Candelaria. Thereafter he devoted himself to agriculture and philanthropy.

Artil'lery (a restricted use of a word properly meaning simply "works of skill," "clever inventions"): (1) All firearms too heavy to be carried in the hand and therefore rested on carriages or masonry foundations; (2) the division of army or navy which uses such arms; (3) the science treating of their theory and practice. The first is divided into *horse* artillery,— light guns mainly for cavalry use, with mounted gunners, and much the same as *flying* artillery, for rapid evolutions in the field, whose gunners are either mounted or ride on the gun-carriages of ammunition wagons when moving; *field* artillery, for general infantry service,— sometimes used to include the foregoing, but commonly specialized to mean the same as *foot* artillery, with unmounted gunners; (*light* artillery includes both these classes, as distinguished from the following); and *heavy* artillery,— all that is not mobile enough for field evolutions,— divided into *siege* or *garrison* artillery, for breaching the walls of fortresses or defending field works, and *coast* artillery, for permanent works, with carriages too heavy for transport, classed as siege, casemate, barbette, and mortar carriages.

A *park* of artillery is a complete set of artillery equipment,— including the guns, carriages, caissons (see AMMUNITION, under "ammunition wagons"), repair outfit, harness, field forges, etc., — gathered in one spot, in barracks or in action; in the latter case the reserve equipment is "parked" out of range of the enemy's fire. A *train* of artillery is a certain number of pieces mounted on carriages and with all their furniture, ready for marching. "Artillery carriages" means either wagons for carrying ammunition or supplies, as above; or gun-carriages, to draw the guns with or fire them from, which may be either stationary as for coast service and permanent works, or movable as in field service. The part which rests on the ground in firing is called the *trail;* the detachable pair of wheels by which it is drawn about, in addition to the fixed pair, is called the *limber*, and the gun is said to be "unlimbered" when they are taken away to let the gun be served, and "limbered up" when they are attached.

The old word "cannon" is not now used by professionals, but "gun" instead. The volume of a gun's service is defined either by the diameter of its bore, as 6-inch, 12-inch, etc.; or by the weight of the spherical iron solid shot it holds, as 12-pounder, 18-pounder, etc. (often abbreviated to 12's, 18's, etc.). The latter characterization has long been used to denote calibre only, without reference to the actual weight of the projectile it fires: thus, a 12-pounder may fire a 30-pound conical shell. This is necessarily so since the entire disuse of spherical shot (see AMMUNITION).

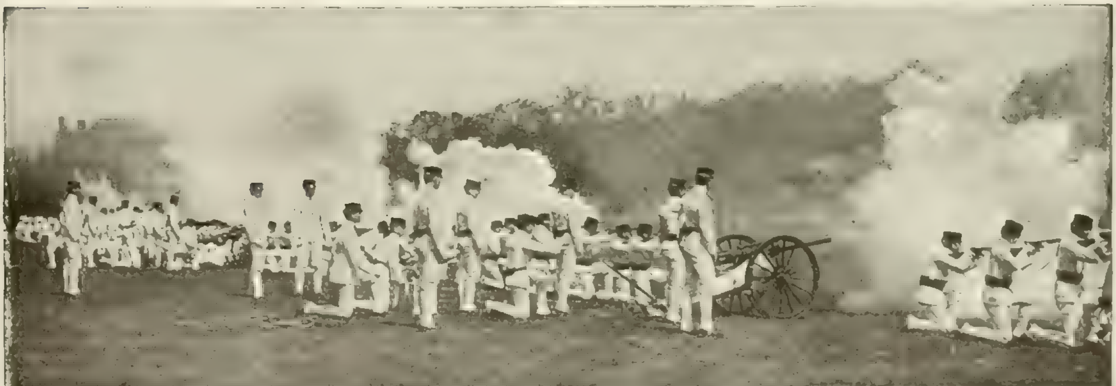
The relation of artillery to small-arms was essentially the same before the invention of gunpowder as afterward: hand-arms, as arrows, darts, slings, swords, etc., corresponded to small-arms and the bayonet; while the artillery consisted of machinery too heavy to be held up, for throwing large projectiles, the power being springs, levers, or weights. Midway between them, however,— as the matchlock arquebuse, rested on the ground to fire, was between small-arms and artillery, but a far more efficient weapon,— was the crossbow or arbalist: a heavy bow with steel or horn frame, stretched by a winch or in its larger sizes by a windlass, and shooting a notched quarrel (that is, a quadrate or square-headed bolt), or sometimes stones or balls of lead. It could be carried by a hunter, or fixed on field or deck; could penetrate armor, and was so destructive as to be prohibited by the Church except in war against the Infidel; and in the early Middle Ages was as decisive in naval or siege warfare, when well handled, as modern artillery, winning many important sea fights and others; but in the field it was too slow for the highest efficiency, as it could be fired only twice a minute. Its larger sizes were true artillery in the modern sense; and like it, but heavier, were the ballista, springal, and onager, which threw stones from a bucket or bag, also beams and masses of inflammable material, at or over walls of besieged places. The catapult, mangonel, and trébuchet (the latter a machine of surprising accuracy and power, as proved by an experimental model made by Prince Louis Napoleon in 1850, and used to breach walls) threw the same missiles by means of a spring lever balanced by a heavy weight, and held down by a windlass.

The introduction of modern gunpowder artillery is clouded by unverifiable legends and confused with the use of explosive mixtures to make a terrifying noise, and with the throwing of inflammable materials by the machines above mentioned. If the Chinese invented it, as alleged, they did it so ineffectively that the great progressive military genius Timur (1333-1405) did not think it worth using; and if the Spanish Saracens used it in Spanish sieges in the 12th century, they did not employ it against Northern foes, nor did the latter borrow it; whereas within a few years of the first verifiable European notice we have it,— a Florentine order of 1326 relating to the manufacture of cannon and iron balls, — it had gone over Europe like wild-fire. The Germans used it at Cividale, Italy, in 1331; Edward III. by at least 1338; the latter formed a regular artillery train of iron and brass cannon in 1344 (in which year also Petrarch speaks of it as familiar and common), and employed it at Crécy in 1346, though ineffectively. Naturally cannon came before small-arms: even so, the first were excessively clumsy in size and construction, —bell-shaped tubes with a touchhole for a train of priming powder set off by a fuse or red-hot iron above; made of iron bars hooped together, or of hand-hammered and bored iron, copper, or brass cylinders; and supported on immense platforms drawn by scores or even hundreds (as with Mohammed II.'s cannon at the siege of Constantinople in 1453) of draft animals, or of men. Sometimes they were not even closed tubes, but open at breech as well as muzzle, the shot being wedged in; sometimes they had no carriages, but were rolled into position and wedged or blocked there. They were mortars rather than cannon in the modern sense, being short and wide-mouthed, and sending off their balls or stones at a great elevation, and were known as bombards or vases. They were of use mainly in siege work; and it was not till toward 1500 that field artillery in its modern sense came into much use, Charles VIII.

ARTILLERY DRILL—THE FORMATION OF THE HOLLOW SQUARE.

ARTILLERY DRILL.

ARTILLERY DRILL—PREPARING TO MOVE GUNS.



ARTILLERY DRILL.

of France utilizing it in his Italian campaigns from 1488 onward.

There was no permanent artillery organization: the gunners were detailed from garrisons, and disbanded and sent back there as soon as the campaign was over; and in England the command in the field was by the Master of the Ordnance, an artillery commissary-general in effect. The transport cattle were hired or impressed, and the drivers of gun-carriages were ordinary teamsters hired by contract or secured for the occasion. Curiously, these last did not form a part of the military body till Napoleon's time.

The 16th century developed this arm greatly in volume, but not so much in science: projectile mathematics were rudimentary, and the imperfect mobility of the guns crippled their usefulness in battle — once they had fired a few rounds in advance of the troops to clear a path and cow the enemy, their service was nearly at an end, as they could not fire when their own troops were in front of them nor move in front or flank to avoid them (the battle of Pavia was lost by this); and were regularly captured and retaken as either side gained ground. Francis I., however (1515–47), lightened their make and took care to secure the best draft horses, and won Marignano (1515) with them; Louis XII. (1498–1515) owed much of his success in the Italian wars to this arm: and Charles V. (1519–55) shared in its development, his Netherland subjects being so forward in it that Henry VIII. employed Dutch gunners to instruct his men. The use of cast bronze, giving surer bore and calculability, as well as lightness for a given power, became common; the bell-shaped mortars gave place to 18-pound culverins for siege work, and to 2's, 4's, 6½'s, and 8's (called falcons, falconets, and sakers) in the field. The great difficulty of carriages also,— to find one easily drawn yet stable enough to fire from,— was partially surmounted; and in Holland the miscellaneous calibres and classes of cannon were reduced to four — 6's, 12's, 24's, and 48's. The Dutch and Huguenot religious wars in the latter part of the century developed the rudiments of a genuine system of artillery tactics, the use of the arm in connection with other arms as part of a tactical whole.

The first half of the 17th century is the first great landmark in the history of artillery. Henry IV. of France in his later years (d. 1610) occupied himself greatly with it; his minister Sully was master-general of artillery, and turned out over 400 pieces; and Maurice of Nassau (1584–1625), son of William the Silent, was much concerned with it. But its re-creator was Gustavus Adolphus (1611–32), who made it almost the centre of his system of warfare. Seeing that weight of ball was of minor consequence with the human body as a target, or length of range at close quarters, he devoted his whole attention to securing mobility and rapidity of fire. The former he obtained by putting nothing above a 12-pounder into the field, and by having a very light gun constructed, the fact that it would bear but a small charge being immaterial: it was made of a "thin cylinder of beaten copper, screwed into a brass breech, strengthened with four iron bands," the whole covered with mastic, cords, plaster, and finally boiled and varnished leather. It was called the *kalter* or the "leather gun," and could be drawn about by the two gunners who served it. But the light charge it could bear made its range too short for the best results, and later it was replaced by a four-pound iron cannon, drawn by two horses. He had also heavier guns to beat down defenses, which in retreat he protected by the lighter ones. Rapid fire he secured by inventing the cartridge instead of pouring in powder, and his cannon could be fired faster than the ordinary musket. The kalter guns were first introduced during his Polish wars; in the Thirty Years' war his success was greatly helped by his improved artillery against the Imperialists' clumsy weapons and methods. At Breitenfeld (1631), Tilly's guns were mainly 24-pounders requiring 20 horses each and 12 for the wagons, could hardly be moved in action, and were almost at once silenced by the advance of their own troops; at the Lech (1632) Gustavus converged 72 pieces on the enemy at the river bend and make a crossing practicable; at Lützen (1632), Wallenstein's batteries were practically stationary, Gustavus had heavy ones on his wings and centre and moving with them. He attached two guns to each regiment, under the colonel's orders — the "battalion system," but whose defect of dispersion of guns he corrected by also massing strong batteries to concentrate a crushing fire where needed; and he raised the total proportion of guns to 6 per 1,000 men, fully double that of any other nation. He also first saw that field and garrison service were essentially distinct, and separated the two branches of artillery not only in material but men. In England during this century, though the leather guns were used by the Scotch in 1640 on the invasion of England, and the Parliamentary army was crushed at Roundway Down (1643) by artillery, it remained in a comparatively undeveloped state, owing to the lack of the constant wars of the Continent; the complaint was made that there were no expert gunners in England.

In the latter part of the century, the perpetual wars of Louis XIV. led to a still further development of this arm. Even in the first part of his reign it was in a very primitive condition. The artillery officers had no functions whatever in time of peace, their nominal offices being purely titular; Vauban protested against this, but it was not remedied till Vallière's reforms of 1732. In 1671, however, Louvois first established a permanent organization for it, creating a regiment of artillerymen consisting of gunners and workmen, and establishing schools of instruction. The calibres were reduced in number and made uniform — those left (4's, 6's, 8's, 12's, 18's, 24's, and 32's) remain in use still, some of them rifled; bronze and iron were both used; carriages were much improved, made of wrought iron and provided with limbers, a special one invented for coast artillery, and platform wagons introduced. The development under him, however, was more in siege than field artillery. The Dutch and English introduced howitzers (a gun with a powder chamber smaller than the bore, for horizontal shell-firing, combining something of cannon accuracy with mortar calibre), mortars, and explosive shells, both hand and gun; and used canvas cartridges and grape-shot (several iron balls in a canvas case). The Woolwich arsenal was established in 1672. In 1682 the gunners were for the first time put un-

der military discipline, their function being previously considered that of civil artisans, and indeed the master gunners were carried on the civil establishment till 1783; in 1794 it was still thought needful to give the ordnance officers express authority over the gunners, by commission. William III. (1689–1702) formed the first English regimental artillery establishment, in place of detailing men from other arms as needed. England, however, was relatively backward.

The first half of the 18th century saw great extension of the specializing in this arm, and the quality of its items; but not very much invention. In France, Vallière the elder, a practical artillery general of immense ability, made great improvements; he reduced the calibres to five; lengthened the pieces, on the ground that short ones had less range and less accuracy, less ricochet and greater recoil, took more munitions and transport for equal service, and could not be used in sieges; he also greatly extended the training schools, and the continued practice of the arm in time of peace. Less usefully, he fought with success against separating the field artillery from the engineers, as involving two artillery trains instead of one. In England, Marlborough used it with effect as it was; the "Royal Regiment of Artillery" was formed in 1716 (the present body in 1722), and in 1741 the Royal Military Academy was instituted at Woolwich. The manufacture and service were both greatly improved; the English artillery was noted "for its lightness, elegance, and the good quality of its materials." The guns in use at the middle of the century were 24's, 12's, 6's, and 3's, in "brigades" (batteries) of four, five, and six guns, divided into light and heavy brigades; each field gun drawn by four horses, the two leaders driven by artillerymen. In Frederick's wars, the English artillery won great distinction. Frederick himself hardly valued this arm at its full value till the melting away of his trained soldiers compelled him to rely upon it more and more. This was perhaps rather from the extremely poor state in which his father left it, than from lack of understanding; that he realized at least a part of its defects and its importance is shown by the fact that finding the gunners and engineers mostly mechanics of inferior grade, he at once drafted the worst of them into garrisons, replacing them with men of competence and position; and as they had no commissions, and were consequently scorned by the other arms of the service, he gave the officers commissions and extra pay, and ranked them with officers of the guards. But his father had given all his attention to the drill and discipline and physical magnitude of his soldiers, to the neglect of the artillery, which at his death consisted of only one battalion of field and one of garrison, of six and four companies respectively; and Frederick inherited his general policy, though with a larger mind. His artillery was vastly nferior to the Austrian, raised to a preeminent position by Prince Lichtenstein. There were two pieces to a battalion, directed by a corporal without independent authority, and the battalion commander had enough on his mind without attending to artillery, which were expected always to keep a certain distance in advance of the troops, thus scanting their time to fire during an advance, and were usually captured in a sudden retreat from lack of time to limber up. Still they did good service at Rossbach, Hochkirchen, and Leuthen; and Frederick raised the proportion of guns to men, and in 1759 formed the first battery of horse artillery, of 6-pounders and 7-pound howitzers — placing great reliance on howitzers, making much use of them against intrenchments, and after the war attaching 40 heavy pieces to each corps. With only 2½ or 3 guns per 1,000 at the outset, he ended with 5 or 6; he created a horse artillery almost as rapid as cavalry; and although at the beginning of the Seven Years' war he had made the error Gustavus avoided, of using too heavy pieces in the field, he grew to appreciate mobility better, and gradually replaced them by lighter ones, saving the others for siege and garrison guns. His wars made three important changes in artillery tactics: the distribution of small batteries at important points in place of concentrating large ones on centre and flank; the preparation for an advance and the protection of deploying columns by light guns; and the rapid change in position of batteries, made possible by the horse artillery. The latter was employed by the Russians also, each regiment having three howitzers with mounted gunners.

The greatest artillery result of Frederick's wars, however, was in France. This country had been very backward in that arm since Louis XIV.'s time, ammunition and transport being especially crude. In 1765 Gen. Gribeauval, termed the "father of the modern artillery system," — who had held an artillery command under Lichtenstein in the Seven Years' war, and admired the efficiency of the Austrian system,— undertook to reconstruct the French one from the bottom; for many years the fierce resistance he encountered made it impossible, though he succeeded in reorganizing the personnel; but in 1776 he became inspector-general of artillery, and carried through the rest of the most far-reaching reform ever effected in this arm, much of it permanent to this day. He divided it into field, siege, garrison, and coast artillery, with a separate class of material and separate personnel for each. For all material a uniform construction was adopted, tables of construction drawn up, and all possible parts made interchangeable. For lightness and consequent mobility, he made the pieces perfectly plain, reduced the length and weight of field pieces, which he restricted to 12's and under (guns in embrasures or behind parapets, of course, could not be shortened), reduced the charge, and therefore the necessary windage (the difference between the diameter of the projectile and that of the gun-bore). Field guns were limited to 4's, 8's, and 12's, and 6-inch howitzers. In ammunition the old grape and case shot were replaced by sheet-iron canisters holding cast-iron balls. Accuracy of fire was vastly improved by elevating screws and tangent scales, the latter based on the mathematical discovery that the path of a projectile is not flat. For siege and garrison guns he adopted at first the 12's and 16's, 8-inch howitzer, and 10-inch mortar; in 1785 the 8-, 10-, and 12-inch "gomer" mortar (with conical bore). The carriages were strengthened, lightened in draft, and improved in mechanism, and ammunition chests affixed; trunnion poles and the *prolonge* rope (to unite limber with trail, for firing in slow retreat) introduced, and the horses harnessed in pairs instead of tan-

dem; and the *bricole* devised — a collar with rope and hook to which the gunners and foot-soldiers harnessed themselves. A new ammunition wagon carrying fixed ammunition was built. Siege carriages had shafts in place of the field carriages' poles; garrison carriages, wheels in front and a truck in the rear; for coast service there were traversing platforms, with bolt in front and truck in rear on a circular racer. The field artillery was divided into regimental guns and corps or reserve artillery; the latter was subdivided into divisions of eight guns of the same calibre, and a company of artillery assigned to each brigade of four battalions. Eight pieces were also attached to the centre and to each wing. Horse artillery was not introduced till 1791, and horsemen and gunners were combined, each learning the other's work.

In the wars of the French Republic, in 1793, when the divisional organization was adopted, guns were attached to the divisions as well as to battalions; in 1796 Napoleon withdrew them from the latter and abolished the old "battalion system," to the great advantage of both arms, the infantry regiments being impeded by the guns and the guns ill served by the divided command. In 1800 he took the last step in professionalizing the arm, by establishing a driver corps of soldiers in place of outside teamsters. His only change in guns was substituting the 6-pounder of the 8's and 4's, and the use of a 24-pound howitzer, but his tactical improvements were great. He employed with enormous effect the modern system of massing gunfire on selected spots, and could not have won his prodigious victories without it, and like Frederick, as his soldiers were swept away he increased his artillery force, rising from 2½ to about 4 per 1,000. His tactics are still part of the instruction of all soldiers.

The British began their long struggle against France very ill-equipped in all military points, and in none more so than artillery; guns, ammunition, transport, were alike crude and ill arranged, the whole equipment hardly able to move faster than foot pace. The field artillery was simply garrison artillery drafted into the field. Field and siege guns were intermingled, in batteries of 12, each battalion having two; the horses were in tandem of three, the drivers carters on foot. In the years before the Peninsular war (1808–14), however, Major Spearman had transformed it. Horse artillery was introduced in 1793; a battery consisting of two 9's and three 6's (later of 9's wholly), and a 5½-inch howitzer. A driver corps was formed in 1794, consisting of a few subalterns, non-commissioned officers, artificers, civilian drivers and horses — divided into "troops," one added to each company of foot artillery. Battalion guns were abolished in 1802, and six-gun field batteries organized, each of five 6 to 12-pounders and a 5½-inch howitzer; the drivers were to be soldiers; the horses were teamed in pairs, drivers on the off ones, and eight gunners carried on the limbers and wagons. The equipment was lightened and simplified, and ammunition well packed instead of flung into rough boxes. Excellent additions were made to material by the invention of shrapnel shell by Major Shrapnel in 1803, and by the development of the antique rocket from a mere fire-signal to a powerful engine of destruction, by Sir William Congreve in 1806 — the latter first used at Copenhagen in 1807, employed with great efficiency at Leipsic in 1813, in the Peninsular war at the Adour, and in the War of 1812 at Bladensburg.

Between 1815 and the Crimean war, the most considerable changes in material were the invention of a powerful 12-pounder howitzer weighing only 220 pounds, for mountain service, used with great effectiveness in the French campaigns in Algeria, the gun-carriage and ammunition going on muleback; the introduction in 1852 by Louis Napoleon — a hereditary artillery student, and the great work on artillery under his auspices is still a standard — of a 12-pounder to fire either solid shot or shrapnel, known as the "12-pounder Napoleon," and made the sole equipment of a set of field batteries, which did great service in his war of 1859 with Austria; and the application of rifling, though not efficiently developed till later, its use at Sebastopol being a failure. Carriages and ammunition wagons were also improved so that the gunners could ride on them, much increasing mobility; the trail was strengthened; and ammunition was carried in boxes on the limber. French field batteries, from 1827, consisted of four 12's and two 6-inch howitzers, or four 8's and two 24-pound howitzers. In England in 1820 the horses for guns and wagons were increased from six and four to eight and six respectively. In 1822, and in 1829 in France the driver corps was abolished, men being enlisted as «gunners and drivers,» and distributed among the battalions; naturally it worked ill, few men being adepts in gunnery and horse management at once. In 1848 in England, the horse artillery was raised from the two guns, to which it had been skeletonized after 1815, to four, and in 1852 to six, as was the foot artillery; and 20 batteries were formed, several more being added in 1855. Even so, this arm was badly undermanned, and deficient in both number and weight of guns, in the Crimean war, where it was organized in position batteries, with 18's and 8-inch howitzers; heavy field, with 12's and 32-pounder howitzers; field, with 9's and 24-pounder howitzers; horse, with 6's and 12-pounder howitzers; and mountain, with 3's and 4-inch howitzers — each field and horse battery having a rocket section. The French organization was horse artillery, with mounted gunners; line or field, with gunners riding on the ammunition chests; and siege or reserve, with gunners on foot. As the war consisted mainly of the siege of Sebastopol, the field artillery had little scope, though used with notable effect at the Alma and Inkerman, and mortar fire causing a frightful destruction in the Redan at the end; and the relatively great increase of range and accuracy in small arms over that of artillery (not then effective at more than a mile) was making the heavier arm subordinate. Later inventions have restored the balance.

Breech-loading and rifling now come into prominence. The earliest cannon were breech-loaders, a system quicker to charge, easier to clean, and more accurate in adjustment of missile to bore, and thus needing less windage than muzzle-loading. But till lately, mechanical science was not equal to its requirements of nice adjustment, and muzzle-loading superseded it. The defect of smooth-bores, with their straight projectile motion, is inaccuracy at long ranges:

since, as a projectile's centre of gravity rarely coincides with its longitudinal axis, the farther it goes the more its unevenness of mass carries it out of the initial path. A whirling motion corrects this by constantly restoring the balance and carrying it the other way; and this is provided by spiral grooving of the gun channel, which was invented by a German early in the 16th century, but like the other system, was in advance of mechanical development. In 1846 it was for the first time practically applied to ordnance, and rifled siege guns were used against Sebastopol, but they were still too imperfect for efficiency. In 1858 rifled 12's and 4's were adopted by France, and in the Franco-Austrian war of 1859 were used with great effect, increasing the accurate range from 1,450 to 2,500 yards, or nearly double; while the Austrians, for generations pre-eminent not only for handling but material, had only smooth-bore 6's and 12's, and 32-pounder howitzers, with the lesser range. The nature of the country stinted the service of artillery, but it was well developed at Solferino and brilliantly handled by the French at Medole. In 1860 the introduction of the Armstrong rifled breech-loader, first used in the Anglo-Chinese campaign of that year, led to a transformation of English artillery equipment: 7-inch guns, 82 hundredweight, for siege and garrison service, 40's for position batteries, 20's for same or heavy field, 12's of 8 hundredweight for light field, 9's of 6 hundredweight for horse. Field carriages were provided with a gun-metal «saddle» worked by lever and hand wheel, with elevating screw. Ammunition wagons were replaced by separate ammunition columns.

At the outbreak of the American Civil War, the United States, largely owing to Lieut. Rodman of the Ordnance Department,— inventor of the Rodman gun, whose casting by interior cooling and consequent density of channel metal, and its thickness at the seat of charge, enable it to bear a heavier charge without bursting than any other,— headed the world in artillery material: both quality and manufacture were unsurpassed. In 1861 it cast a 15-inch Rodman, the most powerful weapon known; and a 20-inch smooth-bore firing a 1,080-pound shot. Otherwise its equipment was:— Field: wrought-iron rifled 3-inch, range 2,800 yards; bronze 6's and 12's; «Napoleon» 12's, range 1,500 yards, used very effectively within it all through the war; howitzers — 12's, 24's, and 32's, and mountain 12's. Siege and garrison: Cast-iron rifled, 4½-inch; 12's, 18's, and 24's; howitzers, 24's and 8-inch; mortars, 8-inch, 10-inch, and bronze Coehorn (a small light mortar for throwing grenades). Coast (most of it at once turned into field batteries): 32's; 8-, 10-, and 15-inch Columbiads (for both shot and shell, like the Napoleons); 10-inch and 13-inch mortars. There were 18 calibres altogether — 7 of «guns,» 3 of Columbiads, 4 of howitzers, 4 of mortars. Eastern armies began with four 6-gun batteries to each division, about half of them being used as a corps reserve when corps were formed; later the batteries were reduced to four, and in 1863 taken from the divisions as formerly from the battalions, being formed into artillery brigades of 4 to 12 batteries. In the Western armies each infantry brigade had a battery of artillery till 1863, when as in the East a massing system was begun. In the Confederate armies each division had an artillery battalion of four batteries, and each corps two battalions as a reserve. This combined system has been substantially adopted by other powers. The Civil War greatly advanced the importance of artillery, and developed the Napoleonic massing system.

The short Austro-Prussian war of 1866 gave no time for new developments in military science, and in artillery service the victorious Prussians were as usual far behind the Austrians, though their material was better. They used for the first time steel breech-loading rifled guns, nominally 6's and 4's, but using 15-pound and 9-pound oblong shells with percussion fuse; the Austrians had muzzle-loading rifled 8's and 4's, in batteries of eight, employing the brigade system and rocket batteries for the last time. After this war they adopted breech-loading guns, and armed themselves from Krupp's factories.

By the time of the Franco-Prussian war in 1870 the Prussians had made great advances in artillery, and owed a part of their success to their superiority to the French, both in numbers, power, and tactics of this arm. They disused reserve artillery, attaching the batteries to divisions and corps entirely; each cavalry division had two batteries of horse artillery; they pushed their guns well in advance, preparing the way for infantry movements by concentrated fire on an objective point, and firing with deliberation at ranges from 650 to 3,300 yards; while the French wasted their fire at too long ranges, held it too long in reserve, and used it in small batteries instead of masses. Their mitrailleuses, first employed in this war, were a disappointment, though they inflicted great losses on the Prussians in carrying positions, especially when successfully masked, and clearly marked out the great future of machine guns; but for offensive work against field artillery they were not fitted. The Prussians used steel breech-loading 9's and 4's, 3.7 guns per 1,000; the French, muzzle-loading 8's and 4's, with some «Napoleon» 12's, 3 to 1,000.

In the Russo-Turkish war of 1878 nothing new of any sort was brought forward. The Turks had the better guns, the Russians much the greater number; the former used Krupp's steel breech-loaders of 3.2 and 3.5 inches, 2.2 per 1,000 men, the latter bronze breech-loading 9's and 6's, 3.9 per 1,000. In the Spanish-American war of 1898 there was little use for artillery; and the only novelty was the furnishing of smokeless powder after Santiago, when it was no longer needed. A 3.2-inch steel breech-loader and a 3.6-inch field mortar were used. As the siege train was not used, its composition is immaterial. In the Philippines and China 3.2-inch field and mountain guns were used. In the Boer war, owing to the nature of the country and the operations, artillery played but a small part, and developed no new weapons; the Boers, however, had for years laid in a stock of much more improved material than the English.

See Armament of the World; Army; Army of the United States; Ordnance; Projectiles. For ammunition see Ammunition; Explosives; Gunpowder. For the relations of the artillery arm to other services see Coast Defense; Fortification; Siege Works; Tactics.

Artil'lery Company, The Ancient and Honorable, a military organization of Boston, Mass. It was copied from that of London, was formed in 1637, and was the first regularly organized military company in America.

Artil'lery Company, The Honorable, the oldest existing body of volunteers in Great Britain. It was instituted in 1585, and comprises six companies of infantry, besides artillery, grenadiers, light infantry, and yagers. It furnishes a guard of honor to the sovereign when visiting London.

Artil'lery Corps, the official name of the entire artillery service of the United States army.

Artil'lery Schools are institutions established for the purpose of giving a special training to the officers, and in some cases the men belonging to the artillery service. An artillery school at Fort Monroe, Va., first established in 1823, discontinued, and re-established in 1867, gives instruction, both theoretical and practical. The artillery regiments of the regular army have each one foot-battery at the school. The course of instruction is one year, beginning 1 September, and it includes such subjects as ballistics, sea-coast engineering, electricity, mines and mechanisms, artillery, coast-defense, chemistry, explosives, etc. In Great Britain the artillery schools are at Woolwich and Shoeburyness. The Department of Artillery endeavors at Woolwich to give artillery officers the means of continuing their studies after completing the usual course at the Royal Military College, and of qualifying for appointments requiring exceptional scientific attainments. The school of gunnery at Shoeburyness gives instruction in gunnery to officers and men and conducts all experiments connected with artillery and stores. See MILITARY SCHOOLS.

Ar'tist's Letters from Japan, An, a work by the noted American artist, John La Farge. The drift of the book is toward a purer art; but it contains much lively matter — accounts of the butterfly dance in the temple of the Green Lotus, and of fishing with trained cormorants. A thread runs through the letters, tracing the character and progress of the usurping Tokugawa family, from the cradle of their fisherman ancestors to the graves of the great shogun and his grandson in the Holy Mountain of Nikko.

Ar'tocar'pus, the generic name of the bread-fruit tree (q.v.).

Artois, är'twä', the name of a former province of France anciently one of the 17 provinces of the Netherlands. It was bounded on the south and west by Picardy, on the east by Hainault, and on the north by Flanders. It is now almost completely included in the department of Pas de Calais. Artois is a fertile region, producing grain and hops. Its capital was Arras.

Ar'totype. See PHOTOGRAPHY.

Arts, the designation of branches of study in the Middle Ages, originally called the liberal arts to distinguish them from the servile arts or mechanical occupations. These arts were usually classed as grammar, dialectics, rhetoric, music, arithmetic, geometry, and astronomy. Hence originated the terms "art classes," "degrees in arts," "master of arts," still in common use in universities, the faculty of arts being distinguished from those of divinity, law, medicine, or science.

Aru. See ARRU ISLANDS.

Aruba, ä-roo'ba, an island belonging to Holland, off the north coast of Venezuela. It is a dependency of Caraçao and is about 30 miles long by 7 broad. The climate is healthy. Pop. about 7,700.

A'rum, a small genus of tuberous tropical and subtropical perennial herbs (commonly called callas) of the natural order *Araceæ,* with simple leaves and diversely colored convolute spathes, for which they are cultivated either under glass or, in the case of some hardy species, in the open air, as ornamental plants. The naked topped spadices bear staminate flowers just above the pistillate ones at the bases. The tender species are managed like the fancy-leaved caladium (q.v.); the hardy must be planted in rich soil in cool, moist situations and must be well mulched during the winter. *A. maculatum,* lords-and-ladies, cucoo-pint, wake-robin, from Europe, is, with its many cultivated varieties, perhaps the best known hardy species grown in America. The leaves and corms are acrid; but the latter when ripe contain starch which may be extracted and used as a food. In places where it abounds it has long been converted into a kind of arrow-root and has been proposed as a substitute for the potato, but the corms are too small for profitable culture. Some closely related native American plants of somewhat similar habit are skunk cabbage (q.v.), water calla (see CALLA), Indian turnip (see JACK-IN-THE-PULPIT). *Anthurium,* a well-known genus of greenhouse plants, is also nearly allied.

Arundel, ăr'ŭn-děl, **Thomas,** an English prelate, third son of Richard Fitz-Alan, Earl of Arundel: b. in 1352; d. Canterbury, 19 Feb. 1413. He was Chancellor of England and Archbishop of Canterbury. He concerted with Bolingbroke to deliver the nation from the oppressions of Richard II., and was a strenuous opponent of the Lollards and followers of Wyclif.

Ar'undel, Thomas Howard, Earl of. See ARUNDELIAN MARBLES.

Arundel, a small town in Sussex, England, famous as containing Arundel castle, the family seat of the dukes of Norfolk. It is on the small river Arun and has a showy Roman Catholic cathedral erected by the Duke of Norfolk. Pop. (1901) 2,738.

Ar'undel Society, a society instituted in London in 1848 for promoting the knowledge of art by the publication of facsimiles and photographs. It was named for the collector of the Arundelian Marbles.

Ar'unde'lian Marbles, a series of sculptured marbles discovered by William Petty, who explored the ruins of Greece for Thomas Howard, Earl of Arundel, in the reign of the first Stuart kings, James I. and Charles I., and devoted a large portion of his fortune to the collection of monuments illustrative of the arts, and of the history of Greece and Rome. These marbles arrived in England in the year 1627, with many statues, busts, sarcophagi, etc. John Selden published some of the inscriptions which he thought most interesting, under the title of

'Marmora Arundeliana' (1628). Henry Howard, Duke of Norfolk, grandson of the collector, presented them in 1667 to the University of Oxford, where they still remain. The whole collection of inscriptions was published by Humphrey Prideaux in 1676; by Michael Maittaire in 1732; by Chandler in 1763. These inscriptions are records of treaties, public contracts, thanks of the state to patriotic individuals, etc., and many of a private nature. The most curious and interesting is one usually known by the name of the Parian Chronicle, from having been kept in the island of Paros. It is a chronological account of the principal events in Grecian, and particularly in Athenian history, during a period of 1318 years, from the reign of Cecrops (1450 B.C.) to the archbishop of Diognetus (264 B.C.). The authenticity of this chronicle has been called in question, but has been vindicated by many of the most learned men.

Arus'pices, Roman priests and prophets, who foretold events from inspection of the entrails of sacrificed animals. They observed, too, all the circumstances which accompanied or happened during the sacrifice; for example, the flame, the mode in which the animal behaved, the smoke. The origin is to be sought for in Etruria. They were introduced into Rome by Romulus, where they flourished till the time of the emperor Constantine (337 A.D.), who prohibited all soothsaying on pain of death.

Arus'pices, On the Reply of the, an oration by Cicero. After Cicero's recall from exile different prodigies alarmed the people of Rome. The aruspices being consulted, answered that the public ceremonies had been neglected, the holy places profaned, and frightful calamities decreed in consequence. Thereupon Clodius denounced Cicero as the cause of the misfortunes that menaced the city, and on the following day the orator replied in the Senate to the attack. The speech takes rank among the greatest of Cicero's orations, though he had little time for preparation, and suffered under the disadvantage of addressing an audience at first openly unfriendly.

Aruwimi, ä'roo-wē'me, a river of equatorial Africa having its source in the hills to the west of Albert Nyanza and tributary to the Congo. Its length is a little over 800 miles and its breadth at its confluence with the Congo is about a mile. It is navigable up to Yambuya, but beyond that place there are many rapids. In its upper course it is called the Ituri. Stanley discovered its mouth in 1877 and traced a considerable part of its course in his search for Emin Pasha in 1887.

Arve, ärv, a river tributary of the Rhone, which it enters near Geneva after a course of about 50 miles. It flows through the valley of Chamouni, and many of the most famous resorts of Switzerland are found in its vicinity.

Aryabhatta, Hindu astronomer and mathematician of the 5th century: b. 476 A.D. His only known work, the 'Aryabhattiya,' is a mathematical treatise in verse; frequent reference is made to his writings by later Hindu scholars. In the solution of quadratic equations and the application of algebra to geometry and astronomy, he anticipated some of the discoveries of modern algebra. He also announced the correct theory of the diurnal rotation of the earth, and the correct explanation of solar and lunar eclipses. See ALGEBRA, HISTORY OF.

Aryan (är'yăn, or ăr'ĭ-ăn) **Languages,** an important language family frequently styled the Indo-European or Indo-Germanic family of tongues. They have reached a higher development than those of the second great family, the Semitic, and are far in advance of the next one — that comprising the Turanian tongues. Like the Syro-Arabian forms of speech they are inflectional; while those of Turanian origin are only agglutinate. Max Müller separates the Aryan family of languages primarily into a southern and a northern division. The former is subdivided into two classes: (1) The Indic; and (2) the Iranic; and the latter into six: (1) The Celtic; (2) the Italic; (3) the Illyric; (4) the Hellenic; (5) the Windic; and (6) the Teutonic. It is often said that Sanskrit, spoken by the old Brahmins, is the root of all these classes of tongues. It is more correct to consider it as the first branch and assume the existence of a root not now accessible to direct investigation. As an illustration of the affinity among the Aryan tongues the common word daughter may be instanced. It is in Swedish, *dotter;* Danish, *datter;* Dutch, *dochter;* German, *tochter;* Old Hebrew German, *tohtar;* Gothic, *dauhtar;* Lithuanian, *duktere;* Greek, *thygater;* Armenian, *dustr;* Sanskrit, *duhitri;* the last-named word signifying primarily "milkmaid," that being the function in the early Brahman or Aryan household which the daughter discharged. Not only are the roots of very many words akin throughout the several Aryan tongues, but (a more important fact) so also are the inflections. Thus the first person singular of a well-known verb is in Latin, *do;* Greek, *didomi;* Lithuanian, *dumi;* Old Slavonic, *damy;* Zend, *dadhami;* Sanskrit, *dadami;* and the third person singular, present indicative of the substantive verb is in English, *is;* Gothic, *ist;* Latin, *est;* Greek, *esti;* Sanskrit, *asti.*

Ar'yan Race, a name sometimes applied to that particular ethnological division of mankind otherwise called Indo-European or Indo-Germanic, but more properly to the Indo-Iranian group alone. The Indo-European division includes two branches, the western, which comprises the inhabitants of Europe, with the exception of the Turks, the Magyars of Hungary, the Basques of the Pyrenees, and the Finns of Lapland, and the eastern, which comprehends those of Armenia, Persia, Afghanistan, and northern Hindustan. From a multitude of details it has been established that the original mother tongue of all these peoples was the same. It is supposed that the Aryan nations were at first located somewhere in central Asia, probably east of the Caspian and north of the Hindu Kush and Paropamisan mountains. From this centre successive migrations took place toward the northwest. The first swarm formed the Celts, who at one time occupied a great part of Europe; at a considerably later epoch came the ancestors of the Italians, the Greeks, and the Teutonic people. The stream that formed the Slavonic nations is thought to have taken the route by the north of the Caspian. At a later period the remnant of the primitive stock would seem to have broken up. Part passed southward and became the dominant

race in the valley of the Ganges, while the rest settled in Persia and became the Medes and Persians of history. It is from these eastern members that the whole family takes its name. In the most ancient Sanskrit writings (the Veda) the Hindus style themselves Aryas, the word signifying "excellent," "honorable," originally "lord of the soil."

Ar'zachel, a Jewish astronomer: b. in Spain about 1050. He discovered the obliquity of the ecliptic and compiled certain astronomical tables known as the "Toledo Tables."

Arzamas, a Russian town, the capital of a district of the same name, 340 miles east of Moscow. It possesses brickyards, tanneries, and tallow factories, and in the earlier half of the 19th century was distinguished for a school of painting which furnished the greater part of Russia with ikons or sacred pictures.

As, a word which the Romans employed in three different ways: to denote (1) any unit whatever considered as divisible; (2) the unit of weight, or the pound (*libra*); (3) a coin. The *as*, whatever unit it represented, was divided into 12 parts, or ounces (*unciæ*). Scholars are not agreed on the weight of a Roman pound, but it was not far from 237.5 grains avoirdupois, or 327.1873 grammes, French measure. In the most ancient times of Rome the copper coin which was called *as* actually weighed an *as*, or a pound, but in 264 B.C. was reduced to 2 ounces, in 217 to 1 ounce, and in 191 to ½ ounce. In 269 B.C., when silver money was first struck by the Romans, the *as* was superseded as a money of account by the sestertius coined from the more precious metal.

As It Was Written, the title of a romance by Sidney Luska (Henry Harland), the scene of which is laid in modern New York. Sombre and tragic though it is, the romance shows unusual vigor of conception and execution and extraordinary intuitive knowledge of the psychology of the Jewish race.

As You Like It, the title of one of Shakespeare's comedies. Its realism lies in its gay, riant feeling, the fresh woodland sentiment, the exhilaration of spirits that attend an escape from the artificialities of society. The characters all meet in the forest of Arden, where "as you like it" is the order of the day.

A'sa, the third king of Judah. During the first 10 years of his reign his kingdom enjoyed peace and prosperity, but in the 11th year he was attacked by the Ethiopian king Zerah at the head of a vast army, which he completely routed. On his triumphant return Asa was met by the prophet Azariah, who encouraged him to persevere in the extirpation of idolatry. In the 36th year of Asa's reign Baasha, king of Israel, occupied Ramah, and proceeded to fortify it as a frontier barrier. Asa called in the aid of Benhadad, king of Syria, and recovered the city, but incurred the rebuke of the prophet Hanani for seeking help elsewhere than from the Lord. The incensed king threw the prophet into prison. He died after a prosperous reign of 41 years.

Asaba, a-sä'ba, a town in west Africa, on the Niger River, 150 miles from the coast. It is the seat of the supreme court, and contains the central prison, civil and military hospitals, and other public buildings. It is a place of large present importance, and in the evolution of new English interests in Africa may become still more conspicuous.

As'afœt'ida is a gum resin obtained from the root of *Ferula fœtida.* Although the United States pharmacopœia limits the producing plant, it is quite probable that asafœtida is obtained from two or even three or four species of *Ferula, F. narthex, F. fœtidissima, F. jaschkeanum.* The main sources, however, are *F. fœtida* and *F. narthex.* These are coarse herbs of the *Umbelliferæ* family distributed throughout the eastern Asiatic provinces from Persia, Turkestan, Afghanistan. The root is cleaned from the leaves and while growing is cut off close to the ground. This is then covered with leaves and in five or six weeks a slice is cut off, and from the cut surfaces the juice exudes. This on thickening forms the asafœtida of commerce. The chemical composition is complex. It consists of resin, gum, ethereal oil, vanillin, and ferulic acid. Asafœtida is highly prized in the East as a seasoning. In medicine it is stimulant to the sympathetic nervous system and is an excellent carminative, and stimulant of unstriped muscle fibre. It is particularly valuable in expelling flatus from the peristalsis it induces. It is also used in hysteria, but in an empirical fashion. Its further study is desirable.

Asa'ma-Yama, a-sä'ma-yä'ma, an active volcano of Japan about 50 miles northwest of Tokyo, 8,280 feet high. Its latest destructive eruption was in 1783.

A'saph, the Levite and psalmist whom David appointed as leading chorister in the temple. It is supposed that his office became hereditary in his family, or that he founded a school of poets and musicians called, after him, "the sons of Asaph."

As'arabac'ca, a European herb. See ASARUM.

As'arum, a small genus of herbs of the natural order *Aristolochiaceæ*, widely distributed in rich, shady woods throughout the northern hemisphere. They have odd chocolate or purplish, bell-shaped, three-lobed perianths containing 12 horned stamens. The flowers which are borne close to or upon the ground are hidden by the kidney-shaped or heart-shaped leaves. *A. canadense*, wild ginger, or Canada snake-root, is warmly aromatic and is sometimes used as a spice. It is common in the eastern United States and is often cultivated in wild gardens as are also the following species: *A. virginicum, A. arifolium,* both common from Virginia southward; *A. caudatum*, a Pacific coast species, *A. lemmoni* and *A. hartwegii*, both of the Sierra Nevada Mountains, the last found at altitudes of 4,000 to 7,000 feet. *A. europæum* is also cultivated. It was formerly used as an emetic, a role now played by ipecacuanha. Its leaves are still made into snuffs and are deemed efficacious as counter-irritants.

Asben, as-bĕn', a kingdom of Africa, in the Sahara, with an area of about 49,000 square miles. It consists of a succession of mountain groups and valleys and attains in its highest summits a height of over 6,000 feet. The valleys, though separated by complete deserts, are very fertile. The climate is on the whole

healthy, and not unsuitable for Europeans. The principal vegetable productions are millet, wine, dates, senna, indigo, and various kinds of vegetables.

Asbestos, one of the most remarkable substances found in nature. It is a peculiar species of the hornblende family of minerals. Its composition is chiefly silica, magnesia, alumina, and ferrous oxide, and consequently unconsumable, hence its name. The fibres formed by the chemical combination above given are perfectly smooth, and in this respect are different from all other known fibres. Paradoxically, it is the link which completes the chain between the vegetable and mineral kingdoms, and is in fact a mineralogical vegetable possessing the curious properties found in both, for it is at once fibrous and crystalline, elastic and brittle, heavy as a rock in its crude state, yet as light as thistledown when treated mechanically. Added to this, its fibres, soft, white, and delicate, have, by their inherent quality of indestructibility, withstood the action of the elements since the world began; and through all the countless ages, during which the hardest rocks surrounding it have been reduced, this mineralogical mystery has remained intact, having successfully resisted the assaults of fire, acids, and time. Asbestos is found widely distributed throughout the world, although the principal supply of crude asbestos suitable for the manufacture of fireproof cloths and curtains comes from Canada, about 75 miles from Quebec. The Italian mineral has a fine, silk-like fibre, but is lacking in the essential characteristic of strength. The product obtained from South Carolina has a soft, woody, yellowish fibre, which quickly powders under pressure. The South African asbestos, as one might naturally infer, is of a dark slate or black color, with exceptionally long, strong fibres, but owing to its stiff and horny texture, it cannot be manufactured into a fine fabric, hence the superiority of the Canadian asbestos, and its large consumption in the United States.

The mining of asbestos differs radically from the mining of other minerals, since no shafts are sunk, but excavations are made in the open, somewhat after the manner of a stone quarry. Canadian asbestos, however, is found in narrow veins or seams about an inch and a quarter in thickness, and embedded in rock which is easily severed from it. The strata of asbestos, which may be vertical or horizontal, are found in practically detached deposits, and are as elusive as those of zinc-bearing ore, and can only be determined by exploring for them. The rock to which the mineral is attached shows on fresh fracture a serpentine mineral of a green shade containing finely divided particles of chromic and magnetic iron. The asbestos on cleavage presents a brilliant, dark-green surface by reflected light, but the fibres after they are detached are perfectly white. The act of separating the mineral from its matrix of rock is termed "hand cobbing," and after this process the mineral is shipped to various factories in the United States.

The process of manufacture begins by placing the asbestos mineral in a chaser mill, a machine comprising a rotating edge-wheel revolving at the end of a radial arm in a trough, which crushes the mineral, dividing the fibres without destroying them. The result is a snowy mass of mineral wool ready for winnowing, a method of removing the minute particles of rock still clinging to the fibres very much like the winnowing of grain; this is done by means of a blast of air, which separates and blows away the foreign matter, leaving the fibres in a refined state and in proper condition for the third stage of manufacture. This is termed air fibre raising, and as the name implies, the fibres are raised by a current of air produced by a blower of large dimensions through a vertical pipe inclined at a small angle. The object of this procedure will be obvious, when it is stated that the air blown across the fibres causes those of coarser texture to be deposited in a compartment near the bottom of the pipe. The medium fibres will be projected a little higher, and these will fall into a second compartment. The finer fibres will be blown to a higher point, and there collected, while the dust will be carried to the top and deposited. The fibres are in this way sorted into different lots according to their texture, and are ready to be made into articles for which they are best adapted. The fluffy stuff now goes to the carding room, just as though it were genuine wool sheared from a sheep or pure cotton fresh from the plant on which it grows, instead of a mineral substance that in its original state was mined like a lump of anthracite coal. A carding machine, similar to that employed in preparing wool, cotton, or flax fibres before spinning, has been adopted by the manufacturers. The problem of mechanically combing these fibres was no small one, and the carding takes place in a machine having a large central rotating cylinder covered with card clothing, that is, strips of leather set with projecting wires termed teeth. Around the main cylinder there are a number of smaller cylinders, also provided with card clothing, which engages the teeth of the central cylinder rotating in the reverse direction. This machine straightens out the fibres and lays them parallel; after passing through the first breaker, they are fed into a second carding engine or breaker, which is set to a finer gauge than the preceding. A third and last carding process takes place in a machine called a finisher or condenser, when all the irregularities are eliminated, and the fibres are stripped from the final cylinder by means of a fly-comb and are converted into unspun threads, when they are delivered on a traveling apron or endless band, and are gathered into rows by reciprocating scrapers; they are then condensed, and the process is continued in the coiling cans. In spinning the yarn, the rovings are delivered to the spindles on a carriage, which then recedes, when the fibres are twisted, and returns when the spun asbestos yarn is wound on the spindles. The spinning frames do not draw the yarn, and no strain is placed on it until after it is twisted. This brings the manufacture of the fireproof material to a point where it is to be woven into cloth, packing, or other forms; for asbestos is used for divers other purposes than those appertaining to theatres.

While adulterated asbestos may be used in some of the mechanical arts, for theatrical hangings its purity should be 100 per cent; it then forms one of the safest barriers against the calamity of fire. As a matter of fact, much of that which is termed commercially pure asbestos cloth contains from 5 to 20 per cent of combustible matter, but absolutely pure Amer-

ican-made cloth may be obtained, where price is not a primary consideration. Not only is purity essential in asbestos cloth where used for protection against fire, but strength as well; and after asbestos is subjected to a high temperature, it has a tendency to powder, when, owing to its weight, it may break through, and its utility be impaired.

One of the leading manufacturers has made an improvement in weaving asbestos cloth for theatre curtains; it consists of two strands of asbestos spun around a strand of high-temperature-melting brass wire, so that the wire is completely embedded and concealed. These asbestos metallic strands form the warp, so that the threads run the long way of the cloth when finished. The weft, or filling-in cross threads, is made of plain, pure asbestos. Such a curtain will stand well under a severe high-temperature test without breaking. Not only theatre curtains, but set scenery of all kinds may be constructed of asbestos. Scenic artists find it more difficult to paint, but the finer textures may be utilized for this purpose; and although asbestos cloth does not take colors as satisfactorily as cheese cloth and burlap, yet its use should be provided for wherever audiences are to be assembled. Flooring and woodwork in general may be easily replaced by compressed asbestos fibre board, and it has been shown that the latter may be stained, polished, and finished to as high a degree as wood. All the upholstery should be of pure asbestos cloth, and carpeting is also made to take the place of the combustible vegetable and animal fibres now used so extensively. One of the peculiar properties of asbestos carpeting is that the longer it is in service, the tougher it becomes.

Asbestos is utilized in the arts in many other forms than cloth; it may be worked into a pulp, and a fireproof paper is obtained. This paper is now used on roofs, between walls, flooring, etc. Fireproof rope three eighths inch in diameter for the suspension of curtains and other uses is made, having a tensile strength of 1,650 pounds per foot. High-grade asbestos plaster is fireproof, soundproof, and hangs together with great tenacity when subjected to water. Asbestos mineral with rock as it comes from the mine costs $200 per ton, but after it is stripped the long fibres are worth $1,500 per ton. When these are made into cloth it sells for $3 per square yard; when made into curtains, the sewing is done with asbestos thread.

Asbjörnsen, as-byĕrn'sĕn, **Peter Kristen,** a Norwegian folklorist: b. in Christiania, 15 Jan. 1812; d. there, 6 Jan. 1885. While pursuing botanical and zoological studies, and subsequently during various travels at government expense, he collected folk tales and legends, aided by his friend Jörgen Moe, with whom he published 'Norwegian Folk Tales' (1842–4); and 'Norwegian Gnome Stories and Folk Legends' (1845–8; 3d ed. 1870), pronounced by Jacob Grimm the best fairy tales in existence.

Asboth, ŏsh'bōt, **Sandor (Alexander),** a Hungarian-American soldier: b. in 1811; d. in 1868. He came to America with Kossuth in 1851, and became a United States citizen, serving in the Civil War in the Federal army, attaining the rank of a brevet major-general. He was United States minister to Argentina at the time of his death.

Asbury, ăz'bĕr-ĭ, **Francis,** the first bishop of the Methodist Episcopal Church in the United States. He was born in Handsworth, Staffordshire, England, in August 1745; d. in Spottsylvania, Va., 31 March 1816. He joined the local ministry of the Methodists at the age of 16, the itinerant ministry six years later, and was sent by John Wesley as missionary to America at the age of 25. In 1772 he was appointed by Wesley general superintendent of the connection in America, the duties of which office he exercised through the entire period of the American Revolution. Until the termination of the war, the Methodists of America had called themselves members of the Church of England, and their ministers laymen. They now considered the political changes of the country as separating them from that Church, and therefore established an organization for themselves. Francis Asbury was constituted the first bishop of the new Church (1784), which office he held till his death. During the 30 years of his episcopal labors he traveled annually from the Androscoggin to the Gulf of Mexico, and from the Atlantic to the Mississippi, ordained not less than 3,000 preachers, and preached about 17,000 sermons. Identified with the religious interests of this country through the two great struggles which have so greatly modified our political and social character, he became eminently American in his sympathies and character, and left the mark of his native enthusiasm and energy upon the ecclesiastical history of the United States.

As'bury Park, N. J., a city and popular summer resort in Monmouth County, on the Atlantic Ocean, six miles south of Long Branch and 40 miles south of New York city. It is on the line of the Pennsylvania R.R. and the Central R.R. of New Jersey. It adjoins Ocean Grove on the north, being separated from it by Wesley Lake. It was founded in 1869, and given a city charter in 1897. It contains many hotels and boarding-houses, attractive summer dwellings, electric lights and street railways, a national bank, etc. It has a property valuation of more than $3,000,000; and is rapidly becoming nearly as popular a winter as a summer resort. Asbury Park and Ocean Grove were originally laid out by members of the Methodist Episcopal Church for camp meetings and other purposes. Pop. (1900) 4,148; in summer, 25,000 and upward.

As'calon, a ruined town of Palestine, on the sea-coast, 40 miles west-southwest of Jerusalem. It was noted during the Crusades, Godfrey de Bouillon gaining here a great victory over the Egyptians in 1099. Its site is now a complete scene of desolation.

Asca'nius, a son of Æneas and Creusa, who accompanied his father to Italy. He supported Æneas in his war with the Latins, and succeeded him in the government of Latium. His descendants ruled over Alba for 420 years. He is known also as Iulus.

As'caris. See ROUND-WORMS; THREAD-WORMS.

Ascend'ants, in law, the opposites to descendants in succession. When a father succeeds his son or an uncle his nephew, etc., the inheritance is said to ascend or to go to ascendants.

Ascen'sion, an isolated volcanic island, near the middle of the South Atlantic Ocean, about lat. 7° 55′ S.; lon. 14° 21′ W.; area about 34 square miles. It belongs to Great Britain; is the sanatorium for the British West African squadron. There are about 400 inhabitants, mainly government employees and their families. Ascension is celebrated for its turtle, which weigh in many cases from 500 to 800 pounds. This island was discovered on Ascension Day, 1502, by the Portuguese, and hence its name; but it was never formally occupied by any nation till Great Britain took possession of it in 1815, after the transportation of Napoleon to St. Helena.

Ascen'sion, Right, a term employed in astronomy in allusion to the position of a star or other heavenly body. Such position is known when we know the right ascension and declination, these terms corresponding respectively to longitude and latitude as applied to the position of places on the globe. Right ascension is measured on the equinoctial or celestial equator, the first point of Aries being taken as the starting-point; and the right ascension of any star is the distance measured eastward along the celestial equator from the first point of Aries to the point where an hour-circle, passing through the star, cuts the equator. The right ascension is easily found by means of the sidereal clock, which, when the first point of Aries passes the meridian, gives the time as 0 hours, 0 minutes, 0 seconds. By noting on the clock the time at which the body is on the meridian, we obtain the right ascension in time, which may be converted into degrees, minutes, and seconds at the rate of one hour to 15°.

Ascen'sion Day, a religious festival of many churches in commemoration of the ascension of the Saviour. It is a movable feast, always falling on the Thursday but one before Whitsuntide. It was first observed about the 4th century.

Asceticism is the exercise of the faculties in moral and religious practices, the application of St. Paul's comparison between an athlete's and a Christian's life (1 Cor. ix. 24, 27). It is negative, when the object of this exercise is to avoid evil, to curb vicious tendencies, moderate excessive passion, and deny the soul and body any indulgence which might become inordinate or unlawful, and whenever it implies active measures against such disorders as gluttony, sloth, anger, pride, and lust, by abstinence, fasting, watching, self-restraint, modesty, and habits conducive to continence. It is positive, when its object is the exercise or training in the virtues which perfect life, and the cultivation of the means most efficacious for this end, such as devout reading, especially of the scripture, meditation, prayer, examination of conscience, exertion, and sacrifice for the good of others, zealous promotion of good enterprises; in a word, anything that can help one to do what is best, constantly, unhesitatingly, and with facility. This is the aim of all true asceticism, whether based on the principles of natural or of positive and revealed law. This aim, as well as many of the means above numerated, is found to some extent in Pagan and Jewish, as well as in Christian asceticism. The latter employs additional means of inculcating and developing the habit of virtue, such as the religious life, divine worship, and in particular the sacramental system of the Church. Asceticism has some part in every rightly regulated life, even in one based on purely ethical principles; but in Christian life it is most systematic and far-reaching. The whole Christian economy depends on self-denial and the active pursuit of virtue according to fixed principles. Every sincere Christian is, accordingly, an ascetic, some are professedly so, men and women, whether in the conventual cloister or domestic circle, who strive to acquire by daily practice habits of virtue, and to advance in holiness. Naturally counsel and direction are needed in a matter so difficult, and it is for want of due attention to these that asceticism is often misunderstood, and is regarded by some as grotesque, a shield for certain excesses and extravagances, associated often with the external observances of communities like the Essenes, with the singularities of some hermits and anchorites, the frenzy of fanatics like the Flagellants, the exclusiveness of the Brahmins, the ablutions of the Mohammedan, the dream of men like those composing the Brook Farm Community. To appreciate asceticism in its normal exercise, one must study it in the examples of men and women noted for its exercise, or in the books whose guidance they followed, in works of the great ascetical and sermon writers, but chiefly in scripture, and in the life of Christ and of persons distinguished for holiness. See Kempis, 'Imitation of Christ'; Rodriguez, 'Christian Perfection'; Scaramelli, 'Ascetical Directory.'

Ascet'ics, a name anciently given to those Christians who devoted themselves to severe exercises of piety, and strove to distinguish themselves from the world by abstinence from sensual enjoyments and by voluntary penances. Hence those writings which teach the spiritual exercises of piety are termed ascetic writings. Even before Christ, and in the time of the early Christian Church, there were similar ascetics among the Jews, such as the Essenes, also among the philosophers of Greece, and in particular among the Platonics. The expression is borrowed from the Greek word *askēsis* (exercise), used to signify the spare diet of the athletæ, who, to prepare themselves for their combats abstained from many indulgences.

Asch, äsh, a manufacturing town in the extreme northwest corner of Bohemia. It contains a large Protestant and a newly-erected Roman Catholic Church, a real-school, schools of design, weaving, etc. The inhabitants are mainly employed in cotton, woolen, and silk manufacture, bleachfields, and dye-works. Pop. (1900) 18,700.

Aschaffenburg, a-shä'fĕn-bürg, a town of Bavaria, 26 miles east-southeast of Frankfort. The chief edifice is castle of Johannisberg, built in 1605–14. There is also the Pompeianum, an edifice built by King Louis of Bavaria, in imitation of the Casa del questore (commonly called the Castor and Pollux House) at Pompeii. The principal industries are the manufactures of colored paper, tobacco, and liquors. There are also large breweries, and an extensive trade is done in wine and timber. Aschaffenburg long belonged to the archbishops of Mainz. Pop. (1900) 18,091.

Ascham, ăs'kăm, **Roger,** an English scholar: b. Kirby, Wiske, Yorkshire, 1515; d. London, 30 Dec. 1568. While still a child, he was taken into the family of Sir Anthony Wingfield and educated with the latter's children. He made rapid progress in English and classical studies, and was taught archery by Sir Anthony himself. The same generous patron sent him in 1530 to St. John's College, Cambridge, where he read nearly all extant Latin literature, acquiring an elegant Latin style that proved most useful to him later, and developed an especial aptitude for Greek, which he taught to students younger than himself. Besides this, he paid some attention to mathematics, became an accomplished musician, and acquired remarkable skill in penmanship. He received his B.A. degree in February 1533-4, and became a Fellow of his college. His reputation for Greek learning soon brought him many pupils, several of whom later rose to distinction, and students from other colleges attended his lectures. In five years, he afterward said, Sophocles and Euripides had become at his college as familiar as Plautus had been previously, and Demosthenes was as much discussed as Cicero. The beauty of his handwriting and the purity of his Latin led to his being employed to write the official letters of the university. He took an active part in the controversy as to the correct mode of pronouncing Greek, opposing Sir John Cheke's system, but later adopting it. In 1543-4 he wrote his famous treatise on archery, 'Toxophilus,' and in person presented a copy of it to Henry VIII., who so approved of the work that he gave the author an annual pension of £10, which was renewed by Edward VI., whose Latin secretary Ascham became. In 1548 he was appointed tutor to Princess Elizabeth. He read with her all 'Cicero,' the greater part of 'Livy,' the 'New Testament,' in Greek, 'Isocrates,' 'Sophocles,' and portions of 'Cyprian' and 'Melancthon.' Two years later he was nominated secretary to Sir Richard Morysin, ambassador to the Emperor Charles V. Their headquarters were at Augsburg, but Ascham made trips to Louvain, Halle, Innspruck, Venice, and Brussels, visiting famous teachers and scholars. He lived on excellent terms with Sir Richard, reading Greek with him five days in the week. The death of Edward caused the recall of the embassy in 1553. Ascham became Latin secretary to Queen Mary and gave proof of his industry by writing for her within three days 47 letters to persons of high rank, of whom cardinals were the lowest in degree. With the accession of Elizabeth, he was continued in his offices and became in addition private tutor to the queen, reading several hours a day with her in the learned languages. She bestowed on him the prebend of Wetwang in York Cathedral 5 Oct. 1559. His last years were filled with anxiety and care due to domestic afflictions and pecuniary embarrassment. Between 1563 and his death he found relief in the composition of his best known work, 'The Scholemaster,' of which he completed two books. The first is a general discussion of education with arguments in favor of inducing a child to study by gentleness rather than by force. The second is an exposition of his famous method of teaching Latin, by means of "double translation," etc., a method which has received high praise from all subsequent writers on the theory and methods of education. When Queen Elizabeth heard of Ascham's death, she is said to have exclaimed that she would rather have cast £10,000 into the sea than to have lost her tutor, Ascham. Scholars in England and on the Continent mourned for him, and expressed their grief in stately Latin verses. In English literature Ascham has a secure place on account of the strength and vigor of his English prose, highly Latinized though it was in construction and vocabulary. In an age when serious literary composition in English was cultivated but little, and regarded less, the famous words in his dedication of 'Toxophilus' to Henry VIII. sounded a noble and patriotic note. "Althoughe to have written this boke either in Latin or Greeke . . . had been more easier and fit for mi trade in study, yet nevertheless, I supposinge it no point of honestie, that mi commodite should stop and hinder ani parte either of the pleasure or profite of manie, have written this Englishe matter in the Englishe tongue, for Englishe men." His style is without the tricks that Lyby introduced, and has an easy flow and straightforwardness.

Bibliography.— By far the best edition of Ascham's writings is 'The Whole Works of Roger Ascham . . . with a Life by Dr. J. A. Giles' (3 vols. in 4 parts, Lond. 1864-5). This edition includes 295 Latin and English letters, many printed for the first time. 'Toxophilus' was first published in 1545; other editions appeared in 1571, 1589, 1788, 1821, 1865 (by J. A. Giles), 1868 (by E. Arber). 'The Scholemaster' was first issued 1570, and was followed by editions in 1571, 1572, 1573, 1579, 1583, 1589, 1711, 1743. Prof. J. E. B. Mayor published best modern edition in 1863, and E. Arber reprinted the first edition in 1870. The best exposition of Ascham's educational system is in R. H. Quick's 'Essays on Educational Reformers' (1868). *Cf.* also article by Sidney Lee in 'Dictionary of National Biography.'

Aschersleben, ä'sher-lā'bĕn, a town of Prussian Saxony, in the district of Magdeburg. It is walled and entered by five gates, and contains several churches, a synagogue, and a realschool of the first class. There are manufactures of woolen goods, paper, sugar, artificial manures, earthenware, etc. Among several interesting ruins in the vicinity is the old castle of Askanien, the cradle of the house of Anhalt. Pop. (1900) 27,245.

Ascid'ian, a marine animal, so called from *Ascidia*, a genus of *Tunicata*. Ascidians were once regarded as mollusks, and afterward as worms, but when their embryology and early stages were studied and it was found that they passed through a tadpole-like stage, in which the tail is supported by a notochord, and that in other respects they approached the vertebrates, they were placed with the vertebrates in the group *Chordata*. The simple ascidians attain to a large size, *A. callosa* being about two inches in diameter, quite round, and in shape and color much like a potato. The "sea-peach" (*Cynthia pyriformis*) is of the size and general shape of a peach, with its rich bloom and reddish tints. It is common at a depth of 10 to 50 fathoms on both sides of the north Atlantic. While other forms, as *Boltenia*, are stalked and fixed to the bottom, certain pelagic forms, as *Pyrosoma*

and *Salpa* (q.v.), are free-swimming. The compound ascidians, such as *Amarœcium*, grow in white or reddish masses on sea-weeds, rocks, shells, etc., the individual animals being minute. The interesting form *Perophora* grows in bunches on piles and wharves on the southern coast of New England; it is perfectly transparent, so that the heart and circulation of the blood can readily be observed under the microscope. The heart is a straight tube, open at each end; after beating for a number of times, throwing the blood with its corpuscles in one direction, the beatings or contractions are regularly reversed, and the blood forced in an opposite direction. For a general account of the anatomy, development, and metamorphoses of these animals, see TUNICATA.

Ascle'piada'ceæ, a natural order of more than 200 genera and 2,000 species of dicotyledonous herbs and shrubs, most of them with milky juice and many of them twining. The species are widely distributed in the temperate and tropical zones of both hemispheres and are especially abundant in Africa. They differ greatly in their characteristics and uses; some, like *Stephanotis floribunda,* are delightfully fragrant; others, like *Stapelia gigantea,* carrion flower, are repellantly odoriferous. Some species yield a fibre from their stems or their pods; some are used in medicine; others are planted for ornament. They are characterized by opposite or whorled, seldom scattered, entire leaves without stipules; umbels of symmetrical flowers, without calyx and with a five-parted corolla with often reflexed lobes; five stamens attached to the corolla and more or less united around the stigma; pollen grains more or less coherent; the ovary composed of two carpels; style short; stigma discoid; fruit a follicle or pod; seed flattened, with long silky hairs, which buoy it up in the air for dispersal; cotyledons flat. In the United States Asclepias (q.v.), or milkweed, is the principal genus. The more important genera are grouped as follows: TYLOPHOREÆ, *Marsdinia, Stephanotis, Cereopegia, Stephelia, Hoya;* GONOGLOBÆ, *Gonoglobus;* PERIPLOCHÆ, *Periplocha, Streptocaulon;* ASCLEPIADÆ, *Asclepias, Cynanchum, Vincetoxicum.*

Asclepiades, ăs'kle-pī'a-dēz, the name of several ancient Greek writers — poets, grammarians, etc.— of whom little is known, as well as of several physicians, the most celebrated of whom was Asclepiades, of Bithynia, who acquired considerable repute at Rome about the beginning of the 1st century B.C.

Ascle'pias, milkweed, silkweed, swallow wort, the type genus of about 125 species of the natural order *Asclepiadaceæ* (q.v.), the species of which are mostly North American erect perennial weeds with thick, deep roots common in pastures and waste places. Some furnish a fibre strong enough for ropes, and the silky down attached to which is useless for spinning, is often used for stuffing pillows, etc. The young shoots of some species are occasionally cooked like asparagus, which they are said to resemble somewhat. *A. tuberosa,* butterfly-weed, pleurisy root, common in dry banks and fields from Ohio to Georgia, is very showy and seems to deserve a place in the flower-garden. Other well-known American species are *A. rubra, A. purpurascens, A. syriaca,* etc. The few species cultivated for ornament in America are mostly foreign. The genus is named in honor of the Greek god Asclepine, since some of the species are reputed carminatives, sudorifics, and expectorants. Medicinally the milkweeds are of secondary value only. They are irritants, and cause nausea, vomiting, and diarrhœa. They also cause diuresis and diaphoresis, but their exact action is in need of investigation. The eclectic school have been the chief investigators.

Ascoli, äs'kō-lē, or **Ascoli Piceno,** äs'kō-lē pēchā'nō (the ancient Asculum), an Italian town, 90 miles northeast of Rome. The town, one of the most ancient in Italy, is well built, and contains many handsome edifices and noble mansions, and the remains of an ancient theatre, temples, etc. It has manufactories of woolen cloths, leather, hats, cream of tartar, china-ware, sealing-wax, paper, and glass. It has an active trade, and its port, at the mouth of the river Tronto, is much frequented by coasting vessels. Pop. (1901) 28,882.

Ascoli Satriano, äs'kō-lē sä'tre-ä'nō (anc. *Ascŭlum Apŭlum*), a town of southern Italy, 20 miles south of Foggia. Pop. (1901) 8,550.

As'comyce'tes, a large and important group of fungi, so called from their spores being contained in asci or sacs. This group includes mildews, rusts, smuts, the truffle, the morel, and (according to Schwendener and other authorities) the lichens. See Engler and Prantl, 'Die Natürlichen Pflanzenfamilien.' See FUNGI.

Asco'nius (QUINTUS A. PEDIANUS), a Roman historian of the 1st century A.D., who wrote a life of Sallust, a reply to the critics of Virgil, and valuable commentaries to Cicero's orations, some of which are extant.

As'cot, a celebrated English race-course near the southwest extremity of the Windsor park. The annual races, which take place in the second week in June, are attended by the fashionable and sporting public. From the accounts of the Master of Horse for the year 1712, it would appear that they were instituted, not in 1727, as is commonly supposed, but by Queen Anne on 6 Aug. 1711.

Ascutney, ăs-kŭt'nĭ, an isolated granitic mountain on the boundary between Windsor and Weathersfield, Vt. Its summit is 3,320 feet above tide-water; and from it is presented an extensive and beautiful prospect of the valley of the Connecticut.

As'dood, or **Asdoud,** a seaport of Palestine, on the Mediterranean, 35 miles west of Jerusalem. It was the Ashdod of scripture, one of the five confederate cities of the Philistines, and one of the seats of the worship of Dagon (1 Sam. v. 5). It occupied a commanding position on the high road from Palestine to Egypt, and was never subdued by the Israelites. It sustained against Psammetichus a siege of 29 years; was destroyed by the Maccabees, and restored by the Romans. It is now an insignificant village, from which the sea is constantly receding.

Aselli, a-sĕl'lee, **Gasparo,** a famous Italian physician: b. Cremona about 1580; d. 1626. He was professor of anatomy and surgery at Padua, and in 1622 discovered the lacteal vessels, which he seems, however, never to have

understood or described with complete accuracy. He left a treatise, 'De Lactibus' (1627).

Asel'lus, a fresh-water isopod crustacean, allied to the wood-lice (q.v.), common in ponds and standing water, under sticks and stones, and in open caves. These crustaceans differ from the common pill bugs of the land in having a pair of rather long forked two-jointed caudal appendages and antennæ of the second pair reaching to the telson. The body is broad and flat, with a broad shield-like telson, formed by the fusion of the last abdominal segments. There are six pairs of legs arising from the middle region of the body between the head and telson. The female carries her eggs under her breast, behind the head. Respiration is carried on by several pairs of broad, gill-like sacks appended to the broad, flat abdominal legs. Blind individuals occur in caves, which are allied to the true blind *Asellus cæcidotæa.*

Asen, ä'sĕn, in northern mythology, the most powerful of the gods. They included 12 gods and the same number of goddesses, among the most renowned of whom were Odin, Thor, Baldur, Freyr, Frigga, Freyja, Idunna, Eira, and Saga. Their dwelling-place was Asgard. Though this worship was native only to the tribes of Scandinavia, its influence extended throughout ancient Germany, and may still be traced in many German proper names. Thus the German names of the days of the week, which through the Saxons became incorporated into the English language, are derived from this mythology. (See ASGARD.) Asen was also the name of several mediæval czars of Bulgaria.

As'enath, the daughter of Potipherah, priest of On, and the wife of Joseph (Gen. xli. 45, 50).

Asepsis. See ANTISEPTICS.

Asex'ual Generation. See PARTHENOGENESIS.

Asgard, ăs'gärd, the home of the Æsir, or Asen, and the Olympus of northern mythology. The city of Asgard is fabled to have been built in the middle of Ida's plain, the very centre of the universe. Here the Æsir erected a court for themselves with seats for 12 and one high seat for Odin, the All-father, and also a lofty abode for the goddesses, called Vingolf. They worked diligently, played at games, were rich in gold and all precious things, and happy, till three maidens from Jotunheim, the giants' world, crossed Ida's plain and entered Asaheim, when corruption spread among its inmates. Asgard had many mansions, the largest and noblest of which was Gladsheim; while another, not so spacious, but the fairest of all and brighter than the sun, was called Gimli. See SCANDINAVIAN MYTHOLOGY.

Asgill, ăs'gĭl, **John,** an eccentric English writer: b. Hanly Castle, 1659; d. 1738. He was bred to the law, and gained considerable reputation, not only by skill in his profession, but from his pamphlet declaring that man might pass into eternal life without dying. In 1703 he took his seat in the Irish Parliament, but was dismissed after four days on account of his so-called blasphemous pamphlet. In 1705 he sat in the English Parliament for Bramber; but in 1707 he was expelled, nominally on account of his unlucky pamphlet, but really perhaps because of his debts. The remainder of his life he spent in the Fleet and King's Bench prisons, in one of which he died. He wrote a number of pamphlets on the Pretender and on the Hanoverian succession.

Ash (*Fraxinus*), a genus of about 50 species of hardy, ornamental trees of the natural order *Oleaceæ,* natives mainly of North America, Europe, and western Asia. The species are prized for street and park planting for which their usually tall pyramidal or broad-topped habits and light, green foliage, which turns yellow or purple in autumn but which falls early, makes them specially attractive. From the elegance of their forms several species, notably the first mentioned below, have been called the Venus of the forest; the oak being the Hercules. The leaves are rather large opposite, pinnate, and deciduous; the flowers greenish or whitish in panicles, appearing either before, with, or after the leaves; the fruits are rather small samaras. Since grass and other plants do not grow well in the immediate vicinity of the ash it is not a good lawn species. The common ash (*Fraxinus excelsior*), a native of Europe and western Asia, found in its perfection upon loamy soil, often attains a height of 120 or even 150 feet. It also thrives in exposed and elevated situations better than many other trees. Its naked flowers appear long before the leaves, which drop early in the autumn, but during the summer are very ornamental. Its leaflets are sessile and serrated toothed. Its tough, hard, white wood makes excellent fuel and is highly valued for turning (for carriage wheels especially) when the tree has grown rapidly, since the toughness is then very great. It is then particularly valuable for carriage shafts, ladders, handles of agricultural tools, such as rakes, pitchforks, and hoes, where pliability, toughness, and lightness are essential. For such uses its only important rival in America is the hickory. When gnarled, as it occasionally is, it is prepared like "curly" maple for cabinet work and furniture, specially fine-grained specimens being used as veneer. The bark is used to some extent in leather tanning. A large number of cultivated varieties have been produced, among which the most remarkable are: *Monophylla* (erroneously raised by some botanists to the rank of a species), with simple instead of compound leaves or with only one or two small leaflets at the base of the main leaf-blade; *albo marginata,* the leaflets of which are bordered with white; *albo-variegata,* with mottled white and green leaflets; *aurea,* yellow branched; *aurea-pendula,* drooping yellow branches; *pendula,* one of the best weeping trees; *crispa,* with curled and twisted very dark green leaves. The American or white ash (*F. americana*), a very variable species common from New Brunswick to Florida and westward to Minnesota and Texas, but rare south of New Jersey, attains about the same size as the preceding species, but has lighter bark and leaves. The leaflets have short stalks and are entire. In rich, moist, dense woods the trunks often attain a height of 40 feet without a branch, thus furnishing valuable timber, which is used for the same purposes as that of the preceding species. There are many varieties which more or less resemble those of the common ash. The black or water ash (*F. nigra*), common in swamps and upon stream

banks from Nova Scotia to Minnesota and southward to Missouri and Virginia, often attains a height of 80 feet. Its wood is softer than that of the preceding, but, being tough and easily separable longitudinally into layers, is largely used for veneer, baskets, barrel staves and hoops. The name *F. sambucifolia,* by which this species is sometimes called, was given it because the bruised leaves smell like those of elder. The red ash (*F. pubescens* or *F. pennsylvanica*) is common in low ground from maritime Canada to Florida, being especially abundant in the swamps of Pennsylvania, Maryland, and Virginia. It is rare west of Ohio, though found as far west as Dakota and Minnesota. It resembles the American ash in uses and in general appearance. The interior of the outer bark of the branches is cinnamon color or red when fresh. The blue ash (*F. quadrangulata*), common in rich, dry, or moist woods from Michigan and Minnesota to Tennessee and Arkansas, and especially abundant in Ohio and Kentucky, attains a height of 80 to 120 feet. Its branches are more or less four-angled, hence the specific name, and the membranes which give the smaller branches this form are specially noticeable on the young shoots. The inner bark yields a blue color when steeped in water, hence the common name. The green ash (*F. viridis*), a species very widely distributed over Canada and the United States from ocean to ocean, is so called from the brilliant green of its young shoots. It is extensively planted to form windbreaks in Minnesota and the Dakotas on account of its extreme hardiness and because it is easily propagated by seeds and also because it grows very rapidly. It is less valued for its wood than the white ash, but is useful for fuel. The Carolina or water ash (*F. caroliniana,* also referred variously to *F. platicarpa* and *F. americana*) seldom exceeds 40 feet in height, but is noted for its very large leaflets. It is distributed from Virginia to Florida and westward to Arkansas and Texas, being most plentiful in swamps, along water courses and in damp, rich woods. Its wood is used like that of the white ash. *F. cuspidata,* a native of the southwestern United States and northern Mexico, is a shrub or small tree which seldom exceeds 20 feet in height, and on account of its conspicuous panicles of fragrant flowers is often planted in temperate climates for ornamental purposes. *F. velutina,* also sometimes referred to *F. pistaciæfolia,* another species of the same region, seldom attains a height of 50 feet, and not being hardy is confined to southern planting. The manna or flowering ash (*F. Ornus* or *Ornus europæa*), a native of southern Europe and western Asia, is a small tree 25 feet tall which resembles the common ash. It furnishes manna (q.v.), as does also *F. rotundifolia,* which by some botanists is considered a variety of *F. Ornus.* It is a native of Greece. Many other species are of botanical, economic, or ornamental interest, but probably none of as much importance as the species mentioned. The mountain ash (q.v.), a member of the natural order *Rosaceæ,* obtains its name from its ash-like leaves.

Consult: Nicholson, 'Dictionary of Gardening' (1888); Bailey and Miller, 'Cyclopædia of American Horticulture' (1900–2).

Ash, or Ash'es, the fixed residue obtained by burning any part of an organized substance in air. Ash usually contains the following, or some of the following, metallic and non-metallic elements:

Metals	Non-metals
Potassium	Chlorine
Sodium	Bromine
Calcium	Iodine
Barium	Phosphorus
Iron	Sulphur
Manganese	Silicon
Aluminum	Carbon
Copper	
Zinc	

These substances are combined in various forms in the living body of the plant or animal. They are derived from the soil in the case of plants, and chiefly from plants in the case of animals. Different parts of the animal or vegetable frame are characterized by differences in the ash which they leave when burned; thus ash of bones consists largely of phosphate of calcium; the animal fluids and the juices of plants contain chlorid of sodium; sea-plants leave an ash rich in alkaline carbonates and also characterized by the presence of bromids and iodids of the alkalies. (See BARILLA; KELP.) Many grasses contain large quantities of silica, which appears in the ash of these plants. An examination of the ash of plants often leads to important conclusions as to the most suitable manure to employ for enriching the soil in which the plants are to be grown.

Ashes.— The non-volatile, inorganic portion of an animal or vegetable substance left behind after incineration. Ashes consist of the most part of carbonates, sulphates, sulphids, silicates and phosphates of potassium, sodium, calcium, magnesium, manganese, and iron, with occasional admixture of unusual elements such as aluminum. In certain seaweeds iodin is a prominent constituent of the ash, and silica occurs in many rushes. The solid matters taken up by plants are not absorbed in anything like the proportions in which they occur in the soil whence they are derived. This is well illustrated by analyses of the ashes of different plants, growing side by side in the same soil. Thus Kerner gives four such analyses, made on the ashes of (1) the water-soldier (*Stratitoes aloides*); (2) the white water-lily (*Nymphæa alba*); (3) a stonewort (*Chara fœtida*), and (4) a reed (*Phragmites communis*). The results, so far as potash, soda, lime, and silica are concerned, are as follows:

PERCENTAGE COMPOSITION OF ASH.

	Water soldier	Water lily	Stonewort	Reed
Potash	30.8	14.4	0.2	8.6
Soda	2.7	29.7	0.1	0.4
Lime	10.7	18.9	54.8	5.9
Silicic Acid	1.8	0 5	0.3	71.5

These four plants grew close together and the soil from which they drew their supplies was identical, so far as could be discovered. The stonewort, it will be seen, contained a very large quantity of lime, and barely a trace of potash, soda, or silica; while nearly three quarters of the ash of the reed consisted of silica, and there

ASH (Fraxinus excelsior).

1, 2. The unfolding of the bud. 3. A shoot in flower. 4, 5, 6. Andrcgynous flower, from different sides. 7. The stamen, exposed with two anthers on their filament. 8. The pistil. 9. The seed-pod, exhibiting the hanging seeds. 10. Section of the seed-pod. 11. Spray of hanging fruit. 12. Fruit laid open, exposing seed. 13. The two lobes of the seed, showing inner and outer side. 14. Seedling plant.

was less than one ninth as much lime as was found in the stonewort. If we pass from the consideration of different plants growing in the same soil to that of the same plant growing in different soils, the results are equally surprising. Thus Kerner gives analyses of the ash obtained from the foliage and branches of the yew tree (*Taxus baccata*), the specimens analyzed being taken from soils rich in serpentine, limestone, and gneiss, respectively. The results are presented in the accompanying table. It will be seen that there are some slight differences in composition, but when the wide difference in the soils is taken into account it is remarkable that the proportions are so nearly alike.

Substance Found	Nature of Soil		
	Serpentine	Limestone	Gneiss
Silicic Acid	3.9	3.6	3.7
Sulphuric Acid	1.9	1.6	1.9
Phosphoric Acid	8.3	5.5	4.2
Iron Oxid	2.1	1.7	0.6
Lime and Magnesia	38.8	41.2	36.3
Potash	28.6	21.8	27.6
Carbonic Acid	14.1	23.1	24.4

One feature that was prominent in the analyses of the yew-tree ash has been purposely obscured in the table by counting the lime and magnesia *together*. It appears that when a plant needs a certain substance for its growth it will sometimes make use of another substance whose chemical properties are closely similar, provided the more desirable one cannot be had in sufficient quantities. Thus the ash of the yew-trees growing over limestone contained 36.1 per cent of lime and 5.1 per cent of magnesia; and that of the trees growing over gneiss contained 30.6 per cent of lime and 5.7 per cent of magnesia. The serpentine soil, however, was much poorer in lime than either of the others,— serpentine being composed almost entirely of magnesium, silicon, and oxygen,— and the trees growing upon this soil, being unable to obtain the necessary quantity of lime, accepted, in the place of the lime, an equal weight of magnesia, which strongly resembles lime in its chemical properties; the observed quantity of lime in these trees being only 16.1 per cent, while magnesia was present to the extent of 22.7 per cent. The ashes of plants show that in certain cases the plants from which they are obtained possess a wonderful power of collecting large amounts of some particular substance, even when this substance is present in the soil or water in which they are growing in such minute quantities that it can barely be detected by the most delicate chemical tests. For example, the sea-weeds of the North Sea are so rich in iodin that their ashes formed the chief supply of this substance for years,— in fact, until the extensive South American deposits of sodium iodid were discovered. It would naturally be inferred that the North Sea contains considerable quantities of soluble iodids; but the fact is, that no trace of iodin or of iodids has yet been detected in it, by the most delicate tests. Wood ashes have long been used as a source of potash, this substance being readily obtained from them by mere leaching with water. The greater part of the potash of commerce is now obtained from other sources, but the leaching process is still in use in country places where wood ashes are plentiful, the potash so obtained being chiefly used for the manufacture of soap. Wood ashes are also valuable for fertilizing purposes, on account of the potash and phosphorus they contain.

Ash'-fly, the gall-fly of the oak (*Cynips quercifolia*). See GALLS; GALL-FLY.

Ash'-leaved' Ma'ple. See BOX ELDER.

Ash'-Wednesday, the first day of Lent. The name is derived from the ancient custom of putting ashes upon the head as a symbol of humble repentance for sin. In the Roman Catholic Church it is part of the religious service on this day for the priest to put ashes on the forehead of each worshipper while kneeling at the altar rails. In the English Church and in the American Episcopal Church the day is observed with especial solemnity as the opening of the penitential season, and also in the Unitarian "King's Chapel," in Boston, Mass.

Ashantee, a-shän'tē, a negro kingdom of western Africa and practically a part of the British colony of the Gold Coast. Its boundaries cannot be stated with any definiteness, but its area may be roughly estimated at 10,000 square miles. It is in general hilly and is largely covered with forests. It is well watered and extremely fertile, but the climate is unhealthy. Among the trees are the baobab, palms, and cotton trees. The crops are chiefly rice, corn, sugar-cane, and yams, the last forming the staple vegetable food of the natives. The domestic animals are cattle, horses of small size, goats, and a species of hairy sheep. The larger wild animals are the elephant, rhinoceros, buffalo, lion, hippopotamus, etc. Birds are numerous and crocodiles and other reptiles abound. Gold is obtained, being found either in the form of dust or in nuggets. The Ashantees long made themselves well known as being warlike and ferocious, with a love of shedding human blood amounting to a passion. Human teeth and jawbones were worn as personal ornaments, and human sacrifices used to be frequent. On the death of a king or chief enormous numbers of victims were slaughtered with circumstances of revolting cruelty, and there were regularly recurring periods, at intervals of 18 or 24 days, called the great and little *adai*, when human sacrifices were made. Notwithstanding this there exist among the Ashantees certain of the arts of civilization. They excel in the manufacture of cotton cloths and in the fabrication of articles in gold; they make good earthenware, tan leather, and make sword-blades of superior workmanship. The native government is a monarchy. The chief town is Coomassie or Kumasi. The British first came in contact with the Ashantees in 1807, when a treaty was concluded by the governor of Cape Coast with the king of Ashantee, acknowledging the sovereignty of the latter by right of conquest over the coast, including Cape Coast Castle. In 1823 war was proclaimed by the Ashantees against the British, and they succeeded in the following year in defeating a small body of troops led by the governor, who perished with almost all his officers; but in 1826 the Ashantees were completely defeated near Accra. At the close of another war, in 1831, the river Prah was fixed as the bound-

ary between the Ashantee kingdom and the states protected by Great Britain, but the Ashantees soon began to interfere beyond the boundary. Early in 1873 the Ashantees again invaded the territory protected by Great Britain, and Gen. Wolseley (subsequently Viscount Wolseley) was now sent against them. The Ashantee general Amanquantia had concentrated his troops, 20,000 strong, at Amoaful, 20 miles from Coomassie. The British general led to the attack 1,481 English and 708 native troops, whom he formed into a square. The battle began on 31 January, on which day Amoaful was taken. The British continued to advance fighting, the enemy at the same time attempting to break in upon their rear by attacking the troops left at Fommanah. On the 4th Coomassie was entered. The loss of the British in killed and wounded was 300, and a large number ultimately succumbed to the climate. As the king refused to enter Coomassie to sign a treaty, the British set fire to the town and began their return march on the 6th. The treaty signed soon after stipulated that the king of Ashantee should renounce his claims to the protectorate over the allies of Great Britain; that free trade and open communication should be established with the coast, and that the king should pay an indemnity of 50,000 ounces of gold. The last condition was not faithfully observed, but the result of the war was greatly to weaken the power of the Ashantees. The conduct of King Prempeh, a successor of King Koffee, led to the dispatch of another British expedition, which in 1896 entered Coomassie without resistance, and received the abject submission of the king, who was taken and sent into banishment. A British resident has since been stationed in the country, which is now a British protectorate, subordinate to the governor of the Gold Coast, and will no longer be the scene of human sacrifices and slave trading. In June 1898 an agreement was arrived at between Great Britain and France with regard to the boundaries between their respective territories here. The population of Ashantee is estimated at from 1,000,000 to 3,000,000.

Ash'burner, Charles Albert, an American geologist: b. Philadelphia, 9 Feb. 1854; d. Pittsburg, 24 Dec. 1889. He graduated at the head of his class at the University of Pennsylvania, and was appointed assistant State geologist in 1875. He originated a method of surveying and representing the geology of the anthracite coal fields which received the approbation of mining engineers throughout the world. He was also an accepted authority on the natural-gas fields. In 1886 he entered private practice as an expert and became closely associated with the Westinghouse interests. He prepared over 20 of the Pennsylvania State geological survey reports, and contributed to scientific and technical journals.

Ash'burnham, Sir Cromer, an English military officer: b. 1831. He served with distinction in the Indian Mutiny campaign, Afghanistan campaign, the Boer war (1881), the Egyptian, and eastern Sudan campaigns; and was subsequently governor of Suakim.

Ash'burton, Alexander Baring, Lord, an English statesman and financier: b. London, 27 Oct. 1774; d. 13 May 1848. He was the second son of Sir Francis Baring, and the affairs of the famous mercantile house established by his father kept him employed in Canada and the United States for many years. In 1810 he became the head of the house of Baring Brothers, and in 1812 sat in Parliament for Taunton. He was created Baron Ashburton in 1835. He was appointed special ambassador to the United States in 1842 to settle the Northwestern boundary question and other matters in dispute between England and America. A street in Boston, known as Ashburton Place, was named in his honor.

Ash'burton River, a stream in western Australia flowing 400 miles and emptying into the Indian Ocean, lat. 22° S.; lon. 115° W.

Ash'burton Trea'ty, a treaty concluded at Washington in August 1842 by Alexander Baring, Lord Ashburton, and the President of the United States. It defined the boundaries between the United States and Canada.

Ash'by, Turner, an American soldier: b. 1824; d. June 1862. He entered the Confederate army in 1861 and became a brigadier-general. He was especially distinguished for his gallantry. He was killed in a skirmish at Harrisburg, Va.

Ashby-Sterry, Joseph, a well known English writer on the staff of the *Daily Graphic.* He is novelist and poet, as well as journalist, and among his published books are: 'Nutshell Novels' (1890); 'The Lazy Minstrel,' a collection of brilliant verse (1892); 'Naughty Girl, a Story of 1893' (1893); 'A Tale of the Thames in Verse' (1896); 'The Bystander, or Leaves for the Lazy' (1900).

Ashby-de-la-Zouche, ăsh'bĭ-dĕ-la-zooch', a market town in Leicestershire, England, on the borders of Derbyshire, 17 miles northwest of Leicester. It has wide, well-paved streets, and its parish church of Saint Helen is a handsome building with stained-glass windows, carvings, and monuments. The Ivanhoe baths attract visitors, the waters being beneficial for some ailments. The ruins of Ashby Castle, well known to readers of 'Ivanhoe,' which received Mary Queen of Scots as a prisoner, are still visible. Pop. (1901) 4,700.

Ash'dod. See Asdood.

Ashe, ăsh, **John,** an American soldier: b. in North Carolina, 1720; d. 24 Oct. 1781. He was a member of the first Provincial Congress and served in the American Revolution as a brigadier-general of North Carolina troops. Asheville, N. C., was called in his honor.

Ash'er, the name of the eighth son of Jacob. He founded the tribe called after him, which occupied a fertile territory in Palestine along the coast between Carmel and Lebanon.

Asheville, ăsh'vĭl, N. C., a city and county-seat of Buncombe County, on the Southern R.R., near the French Broad River; 275 miles west of Raleigh. It is in a tobacco-growing region; has manufactories of cotton goods, shoes, ice, tobacco, and flour; and is widely famed as a winter and summer resort. The city is 2,350 feet above the level of the sea and is surrounded by impressive mountain scenery. It has the Asheville College for Young Women, Bingham Military School, Asheville School for Boys, Normal College and Collegiate Institute for Young

Women, Home Industrial School for Girls, Asheville Farm School for Boys, Industrial School for Colored Youth, an auditorium centrally situated seating 2,000, and free to conventions, weather bureau, three national banks, and nearly 50 hotels and boarding-houses. It has modern sewerage, electric light and gas plants, a water supply by 17 miles of pipe line from trout streams on the water shed of Mt. Mitchell, and an electric street car system with a trolley road to Sunset Mountains. In the suburbs are the grand estate of Biltmore, established by George Vanderbilt of New York city; one of the finest botanical gardens in the world; Pisgah forest, a hunting preserve of 84,000 acres; Riverside Parks; and Mount Beaumont, 2,800 feet high. Pop. (1900) 14,694.

Ashe'ville College, a non-sectarian educational institution for women, in Asheville, N. C. It was organized in 1842, and at the end of 1899 had 17 professors, 135 students, and grounds and buildings valued at $100,000.

Ash'ford, a market-town in Kent, England, pleasantly situated on the river Stour. There are corn and cattle markets, and the Southeastern Railway Company have their principal locomotive and carriage establishments here. Pop. (1901) 12,808.

Ash'hurst, John, an American surgeon: b. 1839; d. 1900. He was graduated at the University of Pennsylvania in 1857; served as an army surgeon in the Civil War; became surgeon of several Philadelphia hospitals after his return; and was made president of the College of Physicians in Philadelphia in 1898. He held surgical chairs in the University of Pennsylvania; was a member of the principal medical and surgical associations of the country; and besides many individual publications edited the 'International Encyclopædia of Surgery' (1881–1886); and 'Lippincott's New Medical Dictionary.' He was the author of 'Injuries of the Spine' (1867); and 'Principles and Practice of Surgery' (1871).

Ashikaga, ä'she-kä'gä, a town in Japan, 17 miles by rail from Tokyo. From the 9th to the 17th century it was of much importance as a seat of learning. It is now noted for its trade in silk and cotton. Pop. (1898) 21,348.

Ash'kelon. See ASCALON.

Ash'land, Ky., a city of Boyd County, situated on the Ohio River; on the Chesapeake & Ohio, Norfolk & Western, and other railroads. It was chartered as a city in 1870. Its manufactures include cut and wire nails, steel billets, sheet steel, leather furniture, etc., and it is a shipping point for iron ore and coal. Pop. (1900) 6,800.

Ash'land, Ky., an estate in the suburbs of Lexington, famous as the home of Henry Clay. It consists of about 600 acres, 200 of which form a park similar to the large private parks of England. The house in which Mr. Clay lived was a plain structure, two stories in height. After his death the property passed by public sale into the hands of his eldest son, James B. Clay, who took down the old house and rebuilt it.

Ash'land, Ohio, a town and county-seat of Ashland County; on the Erie R.R., 65 miles southwest of Cleveland. It has important manufactures, large trade, a national bank, and several newspapers, and is the seat of Ashland University, a non-sectarian institution, founded in 1878. Pop. (1900) 4,087.

Ashland, Ore., city and county-seat of Jackson County; situated in the extreme southern part of the State, on the Southern Pacific Railroad, 341 miles south from Portland, and 431 miles northerly from San Francisco. Ashland is the seat of the Southern Oregon State Normal School, and has three public school buildings and eight church buildings. The city has an excellent municipal organization and police regulation. Ashland owns its own water system. There is an extensive electric-light and power plant, flour-mill, ice plant, sash and door factories, box factory, quartz-mill, foundry and machine shops, and three newspapers. The Southern Oregon Chautauqua Association is located here. There are valuable gold mines in the mountains near by, some of them almost within the city limits. In the vicinity are found great varieties of other valuable minerals, such as cinnabar, kaolin, marble, sandstone, etc. In the vicinity are many mineral springs, whose waters contain much in the way of medicinal properties. Pop. (1902) 4,000.

Ash'land, Pa., a borough in Schuylkill County, in the valley of the Mahanoy, and on several railroads; 12 miles northwest of Pottsville. It is in the centre of the great anthracite coal field, has extensive mining industries, large machine shops, foundries, and factories, and contains the State Miners' Hospital, a national bank, public hall, and several churches. Pop. (1900) 6,538.

Ash'land, Va., a town of Hanover County, situated on the Richmond, F. & P. R.R., 17 miles north of Richmond. It is the seat of Randolph-Macon College. It was the scene of several battles during the Civil War. Henry Clay's birthplace is within seven miles of the town. Pop. (1900) 1,147.

Ash'land, Wis., a city and county-seat of Ashland County, on Chequamegon Bay, Lake Superior, and several railroads; 80 miles east of Duluth. It has one of the finest harbors on the lake, and beside its general lake traffic is a shipping port for the hematite ore of the great Gogebic Iron Range. To accommodate its iron interests it has a number of enormous ore docks. Other important interests are lumber and brown stone. It has very large charcoal blast furnaces, used for the manufacture of pig iron, and since 1885, when the real development of the Gogebic iron mines began, the city has grown rapidly. Near by is the group of Apostles' Islands. The institutions include the North Wisconsin Academy, Sisters' Hospital (Roman Catholic), and Rhinehart Hospital. Pop. (1900) 13,074.

Ash'lar. See MASONRY AND BUILDING.

Ash'ley, Anthony Evelyn Melbourne, an English statesman: b. 1836. He is the fourth son of the seventh Earl of Shaftesbury, and in 1882 succeeded Mr. Courtney as under-secretary of state for the colonies.

Ash'ley, Lord. See SHAFTESBURY.

Ash'ley, William James, an Anglo-American economist: b. London, England, 25 Feb. 1860. He was graduated from Balliol College, Oxford, in 1881; was Fellow of Lincoln College, Oxford; lecturer in history in Lincoln and Cor-

pus Christi, 1885–8, and professor of political economy and constitutional history at the University of Toronto, Canada, 1888–92. He has been professor of economic history at Harvard University since 1892. He has written 'James and Philip van Artevelde' (1883); 'Introduction to English Economic History and Theory' (1888–93); 'Surveys, Historic and Economic' (1900); edited 'Economic Classics'; translated Schmoller's 'Mercantile System,' and has contributed a large number of articles to English and American economic journals.

Ash'mead-Bart'lett, Sir **Ellis,** an English politician: b. Brooklyn, N. Y., 1849; d. London, England, 19 Jan. 1902. He was educated at Christ Church College, Oxford, and admitted to the bar in 1877. He was examiner of the education department, 1874–80; Conservative member of Parliament from Suffolk, 1885, and from Sheffield, 1885-1902; civil lord of the admiralty, 1885, 1886; and was knighted in 1892. His popularity with political audiences in the early 80's was second only to that of Lord Randolph Churchill, but he lost much of this influence in later years owing to his association with the Turks and Swazis — a connection which subjected him to considerable ridicule in the House of Commons and the press. His chief literary production was 'The Battlefields of Thessaly' (1897), a record of his experiences in the last war between Greece and Turkey.

Ash'mole, Elias, a celebrated English antiquary: b. Lichfield, 1617; d. 1692. He practised as a chancery solicitor till the breaking out of the Civil War, when he retired to Oxford and entered himself of Brasenose College, and engaged in the study of natural philosophy, mathematics, and astronomy. At the Restoration he received the post of Windsor herald and other appointments, both honorable and lucrative. In 1672 appeared his 'History of the Order of the Garter.' Other works of his are: 'The Antiquities of Berkshire' (1719) and his 'Diary' (1717). He presented to the University of Oxford his collection of rarities, to which he afterward added his books and MSS., thereby commencing the Ashmolean Museum.

Ashmolean Museum, a museum at Oxford University, founded by Elias Ashmole (q.v.) in 1679. The building was erected by Sir Christopher Wren in 1682.

Ash'mun, George, an American lawyer: b. Blanford, Mass., 1804; d. 1870. He served for several years in the legislature of his native State and was prominent in Congress in 1845–50. He presided over the Chicago Convention which in 1860 nominated Lincoln for the presidency.

Ashmun, Jehudi, an American missionary: b. Champlain, N. Y., April 1794; d. Boston, Mass., 25 Aug. 1828. He prepared for the Congregational ministry, and became professor in Bangor Theological Seminary. Later he joined the Protestant Episcopal Church and edited one of its periodicals, 'The Theological Repertory.' He discovered his true vocation when he became an agent of the American Colonization Society and took charge of a reinforcement for the colony of Liberia in 1822. He found the colony utterly disorganized, but in six years his energy and ability had thoroughly reorganized it and he left it in a prosperous and orderly condition. He died soon after his return to the United States. He wrote 'Memoirs of Samuel Bacon' (1822), and his own life was written by R. R. Gurley (1839).

Ashochimi, ash-ō-chē-mē, or *Wappo.* A tribe of North American Indians who formerly ranged in California from the geysers to Calistoga hot springs and in Knight's Valley.

Ashraf, a-schräf', a town in Persia, near the southern coast of the Caspian Sea, 56 miles west of Astrabad. It was a favorite residence of Shah Abbas the Great, and was adorned by him with splendid buildings, of which only a few miserable ruins now remain.

Ashtabu'la, Ohio, city in Ashtabula County, on Lake Erie, at the mouth of the Ashtabula River; 54 miles east of Cleveland; on the New York, C. & St. L., the Pittsburg, Y. & A., and the Lake Shore & M. S. R.R.'s. It is the centre of an extensive agricultural and dairying region, and has large manufactories of leather, woolen goods, and farm implements. It has a Carnegie public library, three national banks, city hospital, and numerous large buildings. Its extensive railroad and lake commerce makes it an important transfer shipping point, especially for iron and coal. The city was first settled in 1801, was organized as a township in 1805, and incorporated as a city in 1892. On 29 Dec. 1876, a railroad accident here at a high bridge over the river resulted in the loss of over 100 lives. The city is governed by a mayor and city council elected biennially. Pop. (1890) 8,338; (1900) 12,949.

Ash'taroth, a goddess anciently worshipped by the Jews. Ashtaroth is the Astarté of the Greeks and Romans, and is identified by ancient writers with the goddess Venus (Aphrodite). She is probably the same as the Isis of the Egyptians. In Scripture she is almost always joined with Baal, and is called god, Scripture having no particular word for expressing goddess. She was the goddess of the moon; her temples generally accompanied those of the sun, and while bloody sacrifices or human victims were offered to Baal, bread, liquors, and perfumes were presented to Astarté.

Ashtavakra, ash-tä-va'krä. In Hindu legend, the hero of a story in the Mahabharata. His father, Kahoda, devoted to study, neglected his wife. Ashtavakra, though still unborn, rebuked him, and the angry father condemned the son to be crooked (hence the name, from *Ashtan,* eight, and *vakra,* crooked). At the court of Janaka, king of Mithila, Kahoda was defeated in argument by a Buddhist sage and was drowned in accordance with the conditions. In his 12th year Ashtavakra set out to avenge his father, and worsted the sage, who declared himself to be a son of Varuna sent to obtain Brahmins to officiate at a sacrifice. Kahoda was restored to life, and commanded his son to bathe in the Samanga River, whence the boy becomes perfectly straight. In the Vishnu Purana some celestial nymphs see Ashtavakra performing penance in the water and worship him. He promises them a boon and they ask the best of husbands. When he offers himself they laugh in derision at his crookedness. He cannot recall his blessing, but condemns them to fall into the hands of thieves.

Ash'ton, John, an English antiquarian: b. London, 22 Sept. 1834. He has published a long list of works on history, chap-books, legends, ballads, manners, and customs, caricature and satire, among which are 'Social Life in the Reign of Queen Anne' (1882); 'History of the Chap-books of the 18th Century' (1882); 'Social England under the Regency' (1890); 'When William IV. was King' (1896); 'Gambling in England' (1898); 'Florizel's Folly' (1899).

Ashton, Lucy, the heroine of Sir Walter Scott's novel, 'The Bride of Lammermoor.' Engaged to a man she loves, she is forced to marry another, and dies a maniac on her wedding day.

Ashton'-in-Mak'erfield, a town of Lancashire, England, 15 miles from Manchester, and noted for its potteries, collieries, and cotton-mills. Pop. (1901) 18,700.

Ash'ton-Un'der-Lyne, a market-town of Lancashire, England, 6 miles east of Manchester, on the north bank of the river Tame. It was an ancient Saxon town; the most interesting building is the parish church built in the reign of Henry V. Since 1769 it has grown rapidly through the extension of the cotton manufacture, both the spinning of cotton yarn and the weaving of calicoes being carried on in the town to a great extent. Upward of 20,000 work people are employed in factories. There are also collieries and iron-works in the neighborhood which employ a great many persons. Pop. (1901) 43,900.

Ashura'da, a small island in the southeast corner of the Caspian Sea. It is occupied by Russia as a naval and trading station.

Asia, the largest of the five continental divisions of the earth, lying eastward of the European and African continents, and separated from the American continent by Bering Strait and the Pacific Ocean. It is bounded north, east, and south, respectively, by the Arctic, Pacific, and Indian Oceans, with their various branches and inlets; it is divided from Africa on the southwest by the narrow isthmian Suez Canal; and is connected with Europe on the northwest across the whole breadth of that continent. The natural western boundaries are the Ural Mountains, the Caspian Sea, Caucasus Mountains, the Black Sea, Ægean Sea, the Mediterranean and Red Seas. The sinuosities of the Asiatic coast are very extensive; on the south the chief ocean inlets are the Gulf of Aden; the Arabian Sea with its inlets, the Gulf of Oman, the Persian Gulf, and the Gulfs of Cutch, Cambay, and Manar; and the Bay of Bengal containing the Gulf of Martaban. On the eastern or Pacific coast proceeding northward the principal indentations are the China Sea with the Gulfs of Siam and of Tonkin; the Tung-hai or Eastern Sea; the Hwang-hai or Yellow Sea with the Gulf of Pechili and Korea Bay; the Sea of Japan with the Gulf of Tartary; the Sea of Okhotsk; and Bering Sea with the Gulf of Anadyr. On the north or Arctic coast are the Nordenskjold Sea and the Kara Sea with the Gulf of Obi. The coast line is about 35,000 miles, giving a proportion of one mile of coast line to 496 square miles of surface. From the extreme southwestern point of Arabia, at the Strait of Bab-el-Mandeb to the extreme northeastern point of Cape Deshnef or East Cape, the length of Asia is about 6,900 miles, its breadth from Cape Chelyuskin or Northeast Cape in Siberia to Cape Romania, the southern extremity of the Malay Peninsula, is about 5,300 miles. The total area is estimated at 17,296,000 square miles. The most prominent features of the southern coast are the three great peninsulas of Arabia, India, and the Indo-Chinese Peninsula. The east coast is also flanked with insular and peninsular projections, forming a series of sheltered seas and bays. A series of large islands extends to the southeast of the continent, forming a connection with Australia; while a multitude of smaller islands are scattered over the Pacific and Indian Oceans. The principal peninsulas on the east are Kamchatka and Korea. The larger islands, proceeding from the northeast coast, are Saghalien, the Japanese Islands, the Philippine Islands, Borneo, Sumatra, Java, Celebes, the Moluccas, Papua or New Guinea, which, however, is Australasian rather than Asiatic, and lastly Ceylon at the southeastern extremity of the Indian Peninsula. The Kurile Islands, between Kamchatka and Japan, the islands of Loo Choo, Formosa, and Hainan on the Chinese coast, and the Andaman and Nicobar islands in the Indian Ocean, may also be noticed. On the west or Mediterranean coast the principal islands belonging to Asia are Cyprus and Rhodes. The northern coast, from East Cape or Deshnef, in Bering Strait, and on the Arctic Circle, to the Yalmal Peninsula, in the extreme northwest, is almost entirely contained within that circle. The highest point, Cape Chelyuskin, is about 78° N. The largest group of islands on the north coast is the Liakhov Islands (New Siberia); the largest indentation is the Gulf of Obi, which reaches below the Arctic Circle, and receives the river Obi about that latitude.

Mountains.— The mountain systems of Asia are of great extent, and their culminating points are the highest in the world. There are also vast plateaus and elevated valley regions, but large portions of the continent are low and flat. Such are the greater portions of Siberia, from the Ural Mountains across the north of the continent, and the western central region of the continent, where an area of great depression culminates in the Caspian. The greatest mountain system in Asia, and so far at least as altitude is concerned, of the world, is the Himalayan system, the principal mass of which lies between lon. 65° and 110° E. and lat. 28° and 37° N. It thus occupies a position not very far from the centre of the continent, though nearer the southern edge than the northern. It extends, roughly speaking, from northwest to southeast, its total length being about 2,000 miles, while its breadth varies from 100 to 500 or 600. Different names have been given to different portions of the system, such as Hindu Kush (the northwestern extremity), Karakoram, and Kuen-Lun, while Himalaya is more especially confined to the portion forming the northern barrier of Hindustan; but all these are really portions of the same connected mountain mass. The Kuen-Lun simply forms the northern flank of the mass, and is not, as it has been represented, a distinct chain; while the Karakoram Mountains have so little to distinguish them from the rest of the elevated mass

to which they belong that they may be crossed without the traveler being aware of it. The broadest part of the system, the elevated table-land of Tibet, lies between the Himalaya proper and the Kuen-Lun. The Tibetan Mountains are connected on the east with the mountains of China and with those that spread to the south-east over the Indo-Chinese Peninsula. The Thian-Shan is another great mountain system of Central Asia connected with the Himalayan system by the important Pamir Plateau or "roof of the world" in lon. 70°–80° east; lat. 37°–40° north. The point of junction forms "a huge boss or knot," from which the Thian-Shan runs northwestward for a distance of some 1,200 miles. Between these two systems, which curve round it on the west, lies eastern Turkestan, right in the centre of Asia. The greatest elevations of the Himalayan system are to be found among the Himalayas proper, where is Mount Everest, 29,002 feet high, Kunchinjinga, 28,156, etc. The principal passes here, which rise to the height of 18,000 to 20,000 feet, are the highest in the world. The Kuen-Lun summits reach a height of 22,000 feet. The Himalayas descend by successive slopes to the plain of northern India, which has an elevation of about 1,000 feet above the level of the sea. The Vindhyas cross the peninsula, dividing northern from southern India; the latter is further bounded by the eastern and the western Ghats, which run along the coasts; while the interior consists of elevated table-lands rising toward the south, where they attain in the neighborhood of the Nilgiri Hills an elevation of 7,000 feet. The Himalayas are not only connected with the mountains in the interior of India, and with ramifications into China and the Indo-Chinese peninsula, but on the west with the mountains of Baluchistan and Afghanistan. The Suliman and Hala ranges bound India on the west, and unite with the mountains of Baluchistan; while the Hindu Kush, passing westward through the north of Afghanistan, has continuations more or less distinct through Persia to the Elburz range south of the Caspian, and so onward to Mount Ararat. From this point again it forms connections with the mountains of Armenia, with the Caucasus, with the Taurus range in Asia Minor, and with the mountains which run to the south of Persia. The mountains belonging to this series form the boundaries of an elevated plateau extending from the Mediterranean to the Indus. On the north they are frequently of great elevation, Mount Demavend in the Elburz range reaching the height of 18,460 feet, while Ararat is nearly 17,000. The Thian-Shan system is continued to the northeast by the Altai and Sajansk ranges, the whole separating the Chinese Empire from Russian Turkestan and Siberia. Tengri-Khan in the Thian-Shan Mountains is estimated to have a height of 21,320 feet. A line of moderate elevation extends from the Altai westward to the Ural Mountains. To the east of the Sajansk range the Yablonoi Mountains run northeast toward the coast, along which they are continued northward under the name of Stanovoi to Bering Strait.

Table-lands, Plains, and Deserts.— Tibet forms the most elevated table-land in Asia, its mean height being estimated at 15,000 feet. Its surface is very rugged, being intersected by a number of mountain ranges running generally in an easterly and westerly direction. On the east it is bounded by lofty mountains which separate it from China. Some of the largest rivers of southern and southeastern Asia have their origin in Tibet, including the Indus, the Brahmaputra, the Yang-tse, and the Hoang-Ho. In this region, a numerous series of lakes run in a chain parallel to the Himalayas. Another great plateau, much lower, however, than that of Tibet, is the plateau of Iran, occupying a large portion of western Asia, extending from the Indus to the Mediterranean, and from the Persian Gulf to the Caspian Sea. It comprises the countries known as Afghanistan, Baluchistan, Persia, Armenia, and Asia Minor. It lies at altitudes varying from 2,000 to 8,000 feet above the sea. The eastern half of it consists to a large extent of unproductive wastes. Of great political and strategical importance at the junction of Turkestan, Afghanistan, and India, is the Pamir Plateau, already alluded to, called by the natives "the roof of the world." Its valleys are at an elevation of from 11,000 to 13,000 feet above the sea. Another table-land of smaller extent and elevation is the Deccan Plateau, India, south of the parallel of lat. 25° N. The principal plain of Asia, as already mentioned, is that of Siberia, which extends along the north of the continent and forms a vast alluvial tract sloping to the Arctic Ocean, and traversed by large rivers, such as the Obi, the Yenisei, and the Lena, that convey its drainage to that ocean. Vast swamps of peat-mosses called tundras cover large portions of this region. Southwest of Siberia, and stretching eastward from the Caspian to the Thian-Shan Mountains, is a low-lying tract, consisting to a great extent of steppes and deserts, and including in its area the Sea of Aral, Bokhara, Khiva, and other districts. This is a region of internal drainage, the rivers, among which are the Amu Daria and the Syr Daria, either falling into the Sea of Aral or into other smaller sheets of water. In the east of China there is an alluvial plain of some 200,000 square miles in extent, most of it productive and highly cultivated; in Hindustan there are plains extending for 2,000 miles along the south slope of the Himalayas; and between Arabia and Persia, watered by the Tigris and Euphrates, is the plain of Mesopotamia or Assyria, one of the richest in the world. Of the deserts of Asia the largest is that of Gobi, which is bounded on the north by the Yablonoi and Thian-Shan Mountains, on the south by Tibet, on the east by the Khingan Mountains on the borders of China; while in the west it extends into eastern Turkestan. Large portions of it are covered with nothing but sand or display a surface of bare rock. This desert forms a large part of the country known as Mongolia, the whole of which forms an area of internal drainage, deficient in rainfall. There are also extensive desert tracts in Persia, Arabia, and Hindustan. An almost continuous desert region may be traced from the African desert through Arabia, Persia, and Baluchistan to the Indus.

Rivers and Lakes.— Asia contains some of the largest rivers in the world. It is remarkable among the continents for the number of its rivers, some of them of large size, that never find their way to the ocean, their waters either

ASIA
SCALE OF MILES
Population of places is indicated by different lettering, thus;
200,000 and over HONGKONG
100,000 to 200,000 Agra
50,000 to 100,000 Jerusalem
Smaller Places
Cable and Telegraph
Steamship Routes, Distances in miles
Copyright, 1903, by The Americana Company
ARCTIC OCEAN
RUSSIAN EMPIRE
CHINESE EMPIRE
MONGOLIA
TIBET
EASTERN TURKESTAN
PERSIA
ARABIA
INDIA
SIAM
BORNEO
PHILIPPINE ISLANDS
JAPAN
PACIFIC OCEAN
INDIAN OCEAN
ARABIAN SEA
BAY OF BENGAL
CHINA SEA
BERING SEA
SEA OF OKHOTSK
MALAY ARCHIPELAGO
NEW GUINEA
ARAFURA SEA
BLACK SEA
MEDITERRANEAN SEA
NORTH SEA
ATLANTIC OCEAN
EUROPE
ST. PETERSBURG
MOSCOW
CONSTANTINOPLE
ALEXANDRIA
TEHERAN
DELHI
LUCKNOW
BOMBAY
MADRAS
CALCUTTA
RANGOON
BANGKOK
HONGKONG
CANTON
PEKIN
TIENTSIN
MANILA
SINGAPORE
TOKYO
SUEZ TO BOMBAY 2,917 MILES
SUEZ TO SINGAPORE 6,035 MILES

being lost in the sand or falling into lakes that have no outlet. The chief rivers in western Asia are the Tigris and Euphrates, that rise in the Armenian plateau and fall into the Persian Gulf; the Indus, from the Tibetan plateau, flows through northwestern Hindustan and falls into the Arabian Sea; the Ganges, which rises in the Himalayas and flows eastward through northern Hindustan, and the Brahmaputra, which rises in Tibet and flows through Assam and Bengal, both enter the Bay of Bengal; the Irrawaddy and the Salwen, rising in the mountains of the Indo-Chinese Peninsula, and both flowing through Burma, likewise enter the Bay of Bengal; the Mekong or Cambodia, the largest river of this peninsula, has its sources in the same mountains, and flowing southeastward enters the South China Sea; the Yang-tse and the Hoang-Ho, the two great rivers of China, rise in the Tibetan plateau; and enter the ocean after a winding easterly course; the Amur, the only other great river of eastern Asia, rises in Mongolia, and after a circuitous course enters the Sea of Okhotsk; the great rivers of northern Asia, the Lena, Yenisei, and Obi, have already been mentioned. The Yenisei is believed to have a length of 3,400 miles, the Yang-tse of at least 3,000, the Lena of 2,770, the Hoang-Ho of 2,600. The basin of the Obi, including of course those of its tributaries, the Tobol and the Irtish, is believed to be the largest of any river in the world, except the Amazon and the Mississippi, being considerably over 1,000,000 square miles in area.

The largest lake of Asia is the Caspian Sea, which, however, is partly in Europe, its largest tributary being the Volga. The chief Asiatic rivers falling into this sea are the Kur from the Caucasus, the Aras from Armenia, and the Atrek from northern Persia — the river Ural being partly European, partly Asiatic. The Caspian lies in the centre of a great depression, being 83 feet below the level of the Sea of Azof. East from the Caspian, as already mentioned, is the Sea of Aral, which, like the Caspian, has no outlet, and is fed by the rivers Amu Daria and Syr Daria. Its area is estimated at 27,000 square miles. Still farther east, to the north of the Thian-Shan Mountains, and fed by the Ili and other streams from this system, is Lake Balkash, a somewhat crescent-shaped sheet of water, with an area of 8,400 square miles. The lake has no outlet; its water is clear but very salt and disagreeable. There are also several other smaller lakes in this region, such as Issik-Kul, Kara-Kul, Ala-Kul, Baratala, etc. In the south of Siberia, between lon. 104° and 110° E., is Lake Baikal, a mountain lake from which the Yenisei draws a portion of its waters; its area is estimated at about 12,500 square miles. In the very centre of the continent is the Lob Lake, or Lob Nor, to which all the drainage of eastern Turkestan converges, being conveyed to it by the Yarkand, Kashgar, and other streams. These unite to form the Tarim River, which, from the source of the Yarkand, has a total length of over 1,200 miles. Lob seems to be rather a swampy tract than a lake proper. On the borders of Afghanistan, Persia, and Baluchistan, is a similar swampy lake that receives the Helmund and other streams from Afghanistan. Of the numerous lakes in Tibet Dangra-yum Nor and Tengri Nor seem to be the largest; the former is 45 miles long and 25 broad.

Geology.— Though in population and history the most ancient continent, geologically speaking Asia is considered, as regards its present aspect, to be one of the newest. The principal mountain chains are composed largely of granitic rocks. The Himalayan range of mountains bears a striking resemblance in geological structure to the Alps; they are composed of granite gneiss and mica-schist, with syenite and amphibolites or trap-rocks, particularly primitive greenstone; the Altai Mountains contain granite in layers without alternation of gneiss, argillaceous schist in contact with greenstone, and containing augite, jasper, calcareous rocks, argentiferous lead ore, and copper. The ramifications of the Altai into Russian Asia contain also coal-grit, schists, quartz, and greenstone, rich with lead, silver, and auriferous sand. The lower ranges are covered with transported layers of rolled stones of granite, gneiss, and porphyry, in which are found agates, carnelians, and chalcedonies. In the Kuen-Lun group are found rubies, lapis-lazuli, and turquoises. In the eastern part of the Urals the granite, of which the chain is composed, along with gneiss and other rocks, is extremely rich in iron and copper. The Caucasus contains granite, argillaceous schist, and basaltic porphyry. The great plains of northern India, Mesopotamia, central Asia, and Siberia are regarded as of very recent geological origin. From various indications many geologists are of opinion that the greater part of western Asia was occupied at no very distant period by an ocean, of which the Caspian and Aral Seas are the remains. It is also conjectured that a continental area extending across the Indian Ocean united Asia during the Permian period to Africa and Australia. Siberia is supposed to have been twice submerged during the Palæozoic and the later Tertiary period. A line of volcanic action extends on the eastern coast from Kamchatka through the Philippines and the Malay Archipelago to Aracan in the Bay of Bengal. In Kamchatka there are eight or nine active volcanoes; in the interior of the continent there appear to be none at present active.

Climate, Soil, etc.— The size of Asia, the great altitudes and depressions of the continent, along with the variations of latitude and the disposition of sea and land, etc., afford an inexhaustible source of complexity in the variety and distribution of climate. In Tibet, with a mean elevation of about 15,000 feet, the climate is rigorous, combining great cold with drought; vegetation is scanty, trees almost absent, and the population mostly nomadic; except in the lower valleys, where there is an agricultural population, it is very sparse. The climate of central Asia generally presents extremes of heat and cold, and great deficiency of rain. It has accordingly a deficient vegetation and a scanty nomadic population. The great region of Siberia, which, as already mentioned, is a level or slightly undulating plain, lying wholly within the temperate and frigid zones, has a climate which generally resembles that of similar latitudes in Europe, with the exception of greater heat and drought in summer and greater cold in winter. The rainfall is very moderate, but the drainage is deficient and the soil often becomes

swampy. The vegetation is scanty, consisting mostly of grasses and shrubs in the plains and pine forests on the mountains. There is very little land under cultivation and the population is very thin. The northern part of China to the east of central Asia has a temperate climate with a warm summer, and in the extreme north a severe winter. It is well watered and wooded, possesses a fertile and well-cultivated soil yielding the usual products of temperate regions, and is thickly peopled. The district lying to the south of the central region, comprising the two Indian peninsulas, southern China, and the adjacent islands, presents the characteristic climate and vegetation of the southern temperate and tropical regions. Here, however, the modifying effects of altitude come most largely into play, and every variety of climate and form of vegetation is to be found on the slopes of the Himalayas, and the mountains and plains of southern India and of the eastern peninsula. The part of Asia south of the Himalayas, though not all lying within the tropics, is all subject to tropical influences. Among the principal of these may be reckoned the effects of the tropical heat upon the air-currents. To this cause are due the trade-winds, which, carrying the moisture of the southern seas to the continents to be condensed by the mountain masses against which they strike, by determining the rainfall of the various continental districts, and affecting the size and course of the rivers, produce so many climatic effects. More local in their effects as well as arbitrary in their occurrence, and consequently fatal in their violence, are the cyclones, or circular storms, common in the Bay of Bengal and the China Sea. The normal directions of the monsoons are northeast and southwest; the northeast monsoon begins in April and the southwest in October; but the direction, duration, and intensity of these winds are greatly modified, especially on land, by local circumstances. The soil of the southern regions is usually good, and where moisture is sufficient vegetation is rich and even exuberant. The soil of India is so finely comminuted that it has been said it is possible to go from the Bay of Bengal to the Indus and return again to the sea without finding a single pebble. The rainfall in those regions is extremely irregular. There are belts where hardly any rain falls at all, others of moderate, and others of very heavy rainfall. On the Khasia Hills, to the northeast of the delta of the Ganges and Brahmaputra, the heaviest rainfall in the world takes place, the average fall observed being 550 inches a year. The principal period of rain is during the southwest monsoon. On the mountains which directly face the winds, charged with vapor as they come from the sea, the rain will fall in abundance, while they pass over intermediate plains without parting with their moisture. The rainfall, the course of the rivers, and the irrigation and fertility of the plains of India is accordingly determined by the position of the Himalayas, the Ghats, and other mountain ranges. The high plateau which extends from Asia Minor to the Indus has a temperate climate, with some extremity of heat in summer and cold in winter. Rain falls chiefly in winter and spring. The eastern part of this plateau is deficient in rain, and the soil is poor and unproductive, the western portion, consisting of Asia Minor, is more favored of nature. The desert character of large parts of Arabia, Persia, and Baluchistan has already been alluded to. Some parts of the coast of Arabia, as Yemen and Oman, are fertile, but the greater part, especially on the Red Sea, is barren and desolate. A desert belt surrounds an interior plateau of 1,000 to 3,000 feet in height, and of moderate fertility. Syria is divided between hilly and fertile and low desert tracts. The Japanese Islands, which are traversed by mountains of considerable elevation, and extend over about 15° of latitude, experience a great variety of climates. In the north the climate is rigorous, owing to the Siberian winds; in the south it is mild. The eastern coast is milder than the west, being sheltered by the mountain ranges from the cold winds of the continent. The country generally is fertile and populous. The character and productions of the other islands are mostly tropical.

A greater extreme of cold is reached in North America than in northern Asia, the mean temperature of the east coast of Siberia being above the zero of Fahrenheit; and the heat of southern Asia is less than that of Africa, which has more land lying within the tropics. In Siberia the extremes of temperature are great, exceeding 100° between the mean of the hottest and coldest month on the coast, and being commonly over 60° throughout the country. As the equator is approached the extremes of temperature diminish till at the southern extremity of the continent they approach within 5°. The highest temperature attained in southern Asia is about 112°, the highest mean about 82°. The summers of the northern latitudes, though shorter, attain a maximum of heat not much short of the tropics, the greater length of the day compensating for the less intensity of the midday heat. On the Persian plateau the summer heat is increased by the want of rain, and the severity of the winter by the elevation.

Vegetation.— The plants and animals of northern Asia generally resemble those of similar latitudes in Europe, though the extremes of climate are greater. The plateau extending from Asia Minor to the Himalayas resembles southern Europe in its productions, and the desert belt of Asia has an affinity to the African desert. The characteristic types of Siberia are continued to the high regions of central Asia. The community of type with European forms also extends to North China, where is developed besides a relation with the types of North America. The whole of northern Asia differs from Europe more in species than in genera of vegetable productions. Oaks and heaths are absent in Siberia. The principal mountain trees are the pine, larch, and birch; the willow, alder, and poplar are found in lower grounds. The cultivated plants of Asia Minor and Persia resemble those of southern Europe. In the central region European species reach as far as the western and central Himalayas, but are rare in the eastern. They are here met by Chinese and Japanese forms. The lower slopes of the Himalayas are clothed almost exclusively with tropical forms; higher up, between 4,000 and 10,000 feet, is the region of forests and cultivation, producing all the types of trees and plants that belong to the temperate zone, and having extensive forests of conifers; in the east forest trees are met with at a height of 13,000 feet.


ASIA
(Physical)
SCALE
Statute Miles to one inch
EXPLANATION
EUROPE
AFRICA
ARCTIC OCEAN
PACIFIC OCEAN
INDIAN OCEAN
EAST CAPE
BERING SEA
KAMCHATKA PENINSULA
SEA OF OKHOTSK
SAKHALIN I.
KURILE IS.
MOUNTAINS
STANOVOI
WRANGELL I.
NEW SIBERIA IS.
C. CHELYUSKIN
TAIMYR PEN.
GREAT TUNDRAS
SIBERIAN PLAIN
Lena R.
Yenisei R.
Ob R.
Irtysh R.
YAMAL PEN.
NOVAYA ZEMLYA
NORTH CAPE
ARCTIC CIRCLE
NORTH SEA
BRITISH ISLES
Isotherm of 32
URAL MTS.
Volga
SEA OF AZOV
BLACK SEA
CASPIAN SEA
Caspian Depression Below Ocean Level
KIRGHIZ STEPPE
Drainage
L. BALKHASH
Syr-Daria
WEST TURKISTAN
PLAINS OF
ALTAI
PLATEAU OF KOBDO
MONGOLIAN PLATEAU
GOBI
Divide
L. BAIKAL
YABLONOVOI MTS.
Amur R.
GREAT KHINGAN MTS.
Rainless District
TIAN SHAN
PAMIRS
HINDU KUSH
KARAKORAM MTS.
KUENLUN
NAN-SHAN MTS.
PLATEAU OF TIBET
HIMALAYAS
Mt. Everest
Brahmaputra R.
PLAINS OF INDIA
Ganges
Sutlej
Indus R.
Khaibar Pass
Bolan Pass
PLATEAU OF IRAN
ELBURZ MTS.
Mt. Elbruz
CAUCASUS MTS.
Mt. Ararat
Armenian and Kurdistan Highlands
TABLE-LAND OF ASIA MINOR
TAURUS MTS.
CYPRUS
CRETE
MEDITERRANEAN SEA
Euphrates R.
Tigris R.
MESOPOTAMIA PLAINS
Syrian Desert
Dead Sea
SUEZ
Mt. Sinai
TABLE-LAND OF ARABIA
PERSIAN GULF
RED SEA
TROPIC OF CANCER
GULF OF ADEN
C. GUARDAFUI
ARABIAN SEA
PLATEAU OF THE DECCAN
WESTERN GHATS
EASTERN GHATS
C. COMORIN
CEYLON
BAY OF BENGAL
INDO-CHINA PENINSULA
GULF OF SIAM
C. CAMBODIA
MALAY PEN.
Strait of Malacca
BORNEO
CELEBES
MINDANAO I.
PHILIPPINE IS.
SOUTH CHINA SEA
HAINAN
FORMOSA
Isotherm of 70
Yangtse-kiang
Hwang-ho
GREAT PLAIN OF CHINA
Gulf of Pechili
YELLOW SEA
EAST CHINA SEA
RIUKIU IS.
KOREA PEN.
JAPAN SEA
Fuji-yama
SHIKOKU I.
KIUSHIU I.
NIPPON
YEZO
6500 ft.
13000 ft.
Longitude East from Greenwich


ARCTIC OCEAN
NORTH SEA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
RED SEA
ARABIAN SEA
SEA OF OKHOTSK
JAPAN SEA
YELLOW SEA
EAST CHINA SEA
PACIFIC OCEAN
SOUTH CHINA SEA
BAY OF BENGAL
INDIAN OCEAN
ASIA
(Relief)
SCALE
0 100 500 1000
Statute Miles to one inch
Dark Brown indicates highest land
Dark Blue indicates deepest water

Rhododendrons extend to 14,000 feet, and phanerogamous plants are found at the height of 19,500 feet. The southeastern region, including India, the Eastern Peninsula, and China, with the islands, contains a vast variety of indigenous species, varying with the humidity of the climate and the elevation, the forms of higher latitudes being represented on the mountains. In this region we find growing wild a number of plants that have become of the utmost importance to man, such as the sugar-cane, rice, cotton and indigo, pepper, cinnamon, cassia, clove, nutmeg, and cardamons, banana, cocoanut, areca and sago palms; the mango and many other fruits, with plants producing a vast number of drugs, caoutchouc and gutta-percha. The forests of India contain the oak, teak, sāl, deodar, and other timber woods, besides bamboos, palms, sandal-wood, laurels, fig-trees, etc. The Malay Peninsula contains dense forests of similar kinds. The cultivated plants of India include wheat, barley, rice, maize, millet, sorghum, tea, indigo, jute, opium, etc. North of the tropic wheat is sown in November, and reaped early in April, and a crop of rice or other tropical cereal is sown in June and July, and reaped in September and October. Wheat and barley do not grow in southern India, the winter not being sufficiently severe to prepare the ground for them. Cotton, indigo, sugar, tea, tobacco, coffee, pepper, plantains, mangoes, etc., are cultivated in China. Of the Chinese flora the larger portion resembles the Indian, while much is local. In North China, the country between it and the Amur (Manchuria), and the Japanese Islands, large numbers of deciduous trees occur, such as oaks, maples, limes, walnuts, poplars, and willows, the genera being European but the individual species Asiatic. Among cultivated plants are wheat, and in favorable situations rice, cotton, the vine, etc. Japan and the northern parts of this region are rich in species of the pine tribe. According to elevation the islands of the Asiatic Archipelago display an equal diversity with the mainland, the more tropical types being represented on the lower elevations, the more northern on the higher. Coffee, rice, maize, etc., are extensively grown in some of the islands. A line of demarkation called Wallace's line has been drawn at the Strait of Macassar, at which the flora and fauna of Australia begin to appear, and gradually become more pronounced as the distance from Asia and the proximity to Australia increases. The variety of plants of the desert region of Arabia, Persia, and Baluchistan is comparatively small. The predominance of a few species gives character to the whole region. Vegetation is most abundant in spring, when herbaceous and bulbous plants, which extend through this region from Syria to the Himalayas, are abundant. In Arabia Felix, and the warmer valleys of Persia, Afghanistan, and Baluchistan, where the hills are high enough to afford a sufficient rainfall, aromatic shrubs are abundant. Wheat, barley, cotton, and indigo are cultivated in Arabia, and the date-palm flourishes in the desert. On the mountain slopes of western Arabia (Arabia Felix) the coffee-plant, which has probably been derived from Africa, is cultivated. Gum-producing acacias are, with the date-palm, the commonest trees in Arabia; the latter also extends through Persia, and even reaches the shore of the Caspian. Fleshy plants are characteristic of the most arid portions. In the higher parts of Persia and Afghanistan numerous forms of *Umbelliferæ* of great size, as well as thistles and the borage tribe, are abundant. African forms are found not only extending from the African desert along the desert region of Asia, but from south Africa to Ceylon. The Caspian lowlands is the tract where the saline vegetation that is spread over the whole region of steppes and deserts has its greatest development. This region is regarded as the native country of the melon.

Zoology.— There is a still closer resemblance in the fauna than in the flora of northern Asia to that of Europe. Asia south to the Himalayas, together with Europe and North Africa, forms a continuous region, which Dr. Sclater has designated as the Palæarctic; southeastern Asia, with Sumatra, Java, Borneo, and the Philippines, he calls the Indian region; Africa south of the Atlas, with Arabia, Palestine, South Persia, the dry part of Baluchistan and Sind, form the Ethiopian region; Celebes and the other islands beyond Wallace's line, with Australasia, the Australian region. Nearly all the mammals of Europe occur in northern Asia, with numerous additions to the species. *Quadrumana* are rare, *Carnivora* numerous, especially bears, wolves, and weasels. Moles, shrews, and hedgehogs are common among *Insectivora.* Rodents are represented by marmots, the pika, jerboas, rats, mice, etc. There are numerous species of wild sheep, antelopes, and deer. Of the last, the musk and many others are characteristic. In the Indian region there are several peculiar genera of the *Quadrumana* or monkey tribe. Among the distinctive forms of this region is the elephant, the Asiatic species being distinct from the African. The lion, tiger, leopard, which are considered as Ethiopian forms, the bear, civets, ichneumons, and other carnivorous animals are found. The lion inhabits Arabia, Persia, Asia Minor, Baluchistan, etc., and extends as far east as India, being now, however, confined to Guzerat. The tiger is the most characteristic of the larger Asiatic *Carnivora.* It extends from Armenia across the entire continent, being absent, however, from the greater portion of Siberia and from the tableland of Tibet; it extends also into Sumatra, Java, and Bali. The horse, ass, and camel have their true home in Asia. In the Indian region we also find the rhinoceros, buffalo, ox, deer, squirrels, porcupines, as well as various species of *Edentata.* The ornithology of Europe and northern Asia are identified to a still greater extent. A large number of European species extend over northern Asia as far as Japan. In the Malay Archipelago marsupial animals first occur in the Moluccas and Celebes, while various mammals common in the western part of the archipelago are absent. A similar transition toward the Australian type takes place in the species of birds. Of marine mammals the dugong is peculiar to the Indian Ocean; in the Ganges is found a peculiar species of dolphin. In birds, nearly every order except ostriches is represented. Among the most interesting forms are the hornbills, the peacock, the Impey pheasant, the tragopans, and other gallinaceous birds, the pheasant family being very characteristic of the region. The pheasant proper in the wild state is peculiar

.o northern Asia, the golden pheasant and several other species of pheasants to the northeast. The genera and species of passerine birds are very numerous. The desert region, extending from Arabia to Sind, is chiefly distinguished by the absence of many Indian forms and the presence of some African ones, which, however, are not widely spread, most of them being limited to Arabia and Syria. The chief haunts of the *Reptilia* of Asia are the northern portion of Hindustan, the southeastern peninsula, China, and the islands of Ceylon, Sumatra, and Java. At the head of the reptiles stands the Gangetic crocodile, frequenting the Ganges and other large rivers; the helmeted crocodile and the double-crested crocodile are numerous in various quarters, both insular and continental. Among the serpents are the cobra da capello and the Ceylonese tic-palonga, both among the most deadly snakes in existence; there are also very large pythons, besides sea and fresh-water snakes. There are also a number of species of frogs and toads and of fresh-water tortoises, as well as many terrestrial and aquatic lizards. The seas and rivers of Asia produce a great variety of fish. The *Salmonidæ* are found in rivers flowing into the Arctic and North Pacific oceans, but not in southern Asia. Large numbers are caught. Trout are found in the feeders of the Indus and the Caspian. Sturgeons abound in the Black Sea and the Caspian. Two rather remarkable kinds of fishes are the climbing perch and the eriapthalmus. The well-known gold-fish is a native of China.

Asiatic Races.— The Mongolian race is the most numerous in Asia. It occupies the Chinese empire, Tartary, and probably Japan, with part of the Indo-Chinese Peninsula. It is partly settled, as in China, Japan, and the peninsula; partly nomadic, as in Tartary and Mongolia. The Aryan is the next in numbers, and the most civilized of the Asiatic races. It was until the Mohammed conquest the dominant, as it is still the most numerous, race in India. It also prevails in Persia and in the middle region from Afghanistan to Asia Minor. The Semitic race is widely spread in southwestern Asia, and formerly at least extended to Africa. The Dravidian race in South India, the Malays in the eastern peninsula, and other races locally distributed, have no well-defined relation with the larger races. The Dravidians are variously associated with the Mongols and the Australians. The latter theory is connected with the hypothesis of a southern continent, which also connects these races with Africa. See ETHNOLOGY.

Political Divisions.— A large portion of Asia is under the dominion of European powers. Russia possesses the whole of northern Asia (Siberia) and a considerable portion of central Asia, together with a great part of ancient Armenia, on the south of the Caucasus; Turkey holds Asia Minor, Syria, and Palestine, part of Arabia, Mesopotamia, etc.; Great Britain rules over India, Ceylon, a part of the Indo-Chinese Peninsula (Upper and Lower Burma), and one or two other possessions; France has acquired a considerable portion of the Indo-Chinese Peninsula (Cochin-China, Anam, Tonkin, Cambodia), and has one or two small settlements besides, while to Holland belong Java, Sumatra, and other islands or parts of islands in the Asiatic or Malay Archipelago. The chief independent states are the Chinese empire, much the most populous of all; Japan, Korea, Siam, Afghanistan, Persia, and the Arabian states. The total population of the continent is estimated at 905,000,000.

Religions.— Asia has been the birthplace of religions; the Jewish, Buddhist, Christian, and Mohammedan having their origin in Asia, where they grew up under the influence of still older religions, the Babylonian and that of Zoroaster, both also of Asiatic origin. At present the inhabitants of Asia belong chiefly to the Buddhist religion, which has 530,000,000 to 560,000,000 of followers, that is, nearly one third of mankind. The old faith of Hinduism has 187,000,000 of followers in India. Most of the inhabitants of western Asia, as also of part of central Asia, follow the religion of Islam; they may number about 90,000,000. The Christians number about 20,000,000 in Armenia, Caucasus, Siberia, and Turkestan. Jews are scattered mostly in western and central Asia. A few fire-worshippers, Guebers or Parsi of India and Persia, are the sole remnant of the religion of Zoroaster; while vestiges of Sabæism are found amidst the Gesides and Sabians on the Tigris.

Civilization.— There are to be found in Asia all varieties of civilization, the primitive tribes of northeastern Siberia, the confederations of nomadic shepherds, and great nations in possession of a common stock of national customs, beliefs, and literature, like China; the tribal stage; the compound family, forming the real basis of China's social organization; the rural community, both of the Indian and Mussulman type; the loose aggregations of Tchuktchis, having no rulers and no religion beyond the worship of forces of nature, but professing with regard to one another principles of morality and mutual support often forgotten in higher stages of civilization; and despotic monarchies with a powerful clergy. So also in economic life. While the tribes of the northeast find their means of subsistence exclusively in fishing and hunting, carried on with the simplest implements, among which stone weapons have not yet quite disappeared, and the tribes of central Asia carry on primitive cattle-breeding and lead a half-nomadic life, others are agriculturists, and have brought irrigation (in Turkestan) to a degree of perfection hardly known in Europe.

Internal Communication.— Caravans of camels are the chief means of transport for goods and travelers in the interior; donkeys, yaks, and even goats and sheep are employed in crossing the high passages of the Himalayas; horses are the usual means of transport in most parts of China and Siberia, and in the barren tracts of the north the reindeer and, still farther north, the dog, are made use of. Fortunately the great rivers of Asia provide water communication over immense distances. The deep and broad streams of China, allowing heavy boats to penetrate far into the interior of the country, connect it with the sea; a brisk traffic is carried on along these arteries. In Siberia the bifurcated rivers supply a waterway, not only north and south along the course of the chief rivers running toward the Arctic Ocean, but also west and east; thus a great line of water communication crosses Siberia, and is, with but a few interruptions, continued in the east by the Amur, navigable for more

ASIATIC ART.

1. Dancing Staff from Sumatra.
2. Fetich from Nias.
3. Aino Shuttle.
4. Bashkir Ornament.
5. Bronze Buddha.
6. Helmet.
7. Gauntlet.
8. Japanese Kettle, Silver and Bronze.
9. Singhalese Work.

than 2,000 miles. In the winter the rivers and plains of Siberia become excellent roads for sledges, on which goods are still chiefly transported.

Railways.— In 1900 the lines in existence had a total length of about 30,000 miles, of which two thirds belonged to British India. The portions of the trans-Caspian and trans-Siberian railways already constructed had a length of 3,200 miles. A number of European syndicates held concessions for 3,600 miles of railroads in China, which will traverse regions rich in minerals and agriculture; many of these lines were then in process of construction. The Chinese government owned about 300 miles of railway. The lines are very remunerative, especially that from Peking to Tien-Tsin. Japan is well provided with railroads; the length being 3,200 miles. French Indo-China had only 120 miles, but the French possessions in Cochin-China, Anam, and Tonkin are expected soon to have 2,400 miles, which will greatly help to develop their mineral and agricultural resources. The Dutch Indies are well supplied. Java alone has 1,000 miles. There are as yet no railroads in Persia of any consequence; but Turkey operates 1,500 miles in Asia, and 600 miles more are in construction or projected.

Telegraph communications are in a much more advanced state than the roads. St. Petersburg is connected by telegraph with the mouth of the Amur and Vladivostock (on the frontier of Korea); while another branch, crossing Turkestan and Mongolia, runs on to Tashkend, Peking, and Shanghai; Constantinople is connected with Bombay, Madras, Singapore, Saigon, Hong-Kong, and Nagasaki in Japan; and Singapore stands in telegraphic communication with Java, and Port Darwin in Australia. Finally, Odessa is connected by wire with Tiflis in Caucasus, Teheran, and Bombay.

Trade.— Notwithstanding the difficulties of communication a brisk trade is carried on between the different parts of Asia, but there is no possibility of arriving at even an approximate estimate of its aggregate value. The maritime exports to Europe, the United States, and overland to Russia, have an annual value of about $900,000,000, and the imports of about $750,000,000. Asia deals chiefly in raw materials, gold, silver, petroleum, teak, and a variety of timber-wood, furs, raw cotton, silk, wool, tallow and so on; the products of her tea, coffee, and spice plantations; and a yearly increasing amount of wheat and other grain. Steam industry is only now making its appearance in Asia, and, although but a very few years old, threatens to become a rival to European manufacture. Indian cottons of European patterns and jute-stuffs already compete with the looms of her European sister countries. Several of the petty trades carried on in India, China, Japan, Asia Minor, and some parts of Persia, have been brought to so high a perfection that the silks, printed cottons, carpets, jewelry, and cutlery of particular districts far surpass in their artistic taste many like productions of Europe. The export of these articles is steadily increasing, and Japan supplies Europe with thousands of small articles — applications of Japanese art and taste to objects of European household furniture.

History.— The origin of the name Asia is involved in obscurity, and it is not certainly known whether it arose among the Greeks or was borrowed by them from some Asiatic people. The Greeks seem to have applied it originally only to Lydia, the part of the continent with which they first became acquainted. Modern scholars are inclined to believe that the name Asia is connected with the Sanskrit *ushas,* the dawn, as Europe may be connected with the Hebrew *ereb,* the west or the sun-setting.

The oldest historical documents are of Asiatic origin, and next to the immediately contiguous kingdom of Egypt Asia possesses the oldest historical monuments in the world.

The oldest historical monuments in Asia are those of Assyria (see ASSYRIA), and with them are associated traditions which carry us back to a remote and indefinite antiquity. A similar vague antiquity belongs to the historical traditions of India and China. Criticism, however, reduces all these claims to moderate dimensions, and assigns to the oldest ascertained facts a period not more remote than some 4,000 years from the present.

The earliest facts in the history of Asia, apart from documents and monuments, consist in the migrations of races, the evidence of which is derived from tradition, from language, from customs, and from religion. The earliest known seat of the Aryan race was on the banks of the Oxus. Hence probably from the pressure of the Mongolian tribes to the north they spread themselves to the southeast and southwest, pressing upon the Dravidian inhabitants of India and the Semitic races of southwestern Asia. Finally they drove the Dravidians to the south of India and occupied Persia and other parts of western Asia, spreading into Europe. It is a remarkable circumstance that in this invasion the Aryans appear to have acquired the use of letters from the peoples with whom they came in contact, the Dravidian letters being borrowed in India and the Semitic in Persia as the original basis of the Sanskrit and Zendic alphabets. At a later period the Greeks likewise adopted a Semitic alphabet from the Phœnicians. The Semites have spread within historical times into northern Africa, and their migrations had probably taken a similar course before they were recorded in history. A large portion of the Mongols are still, as they have always been, a nomadic race, and their migrations, carrying everywhere the terror of predatory arms, have spread from the settled part of their own race in China along the north of Asia into northern Europe.

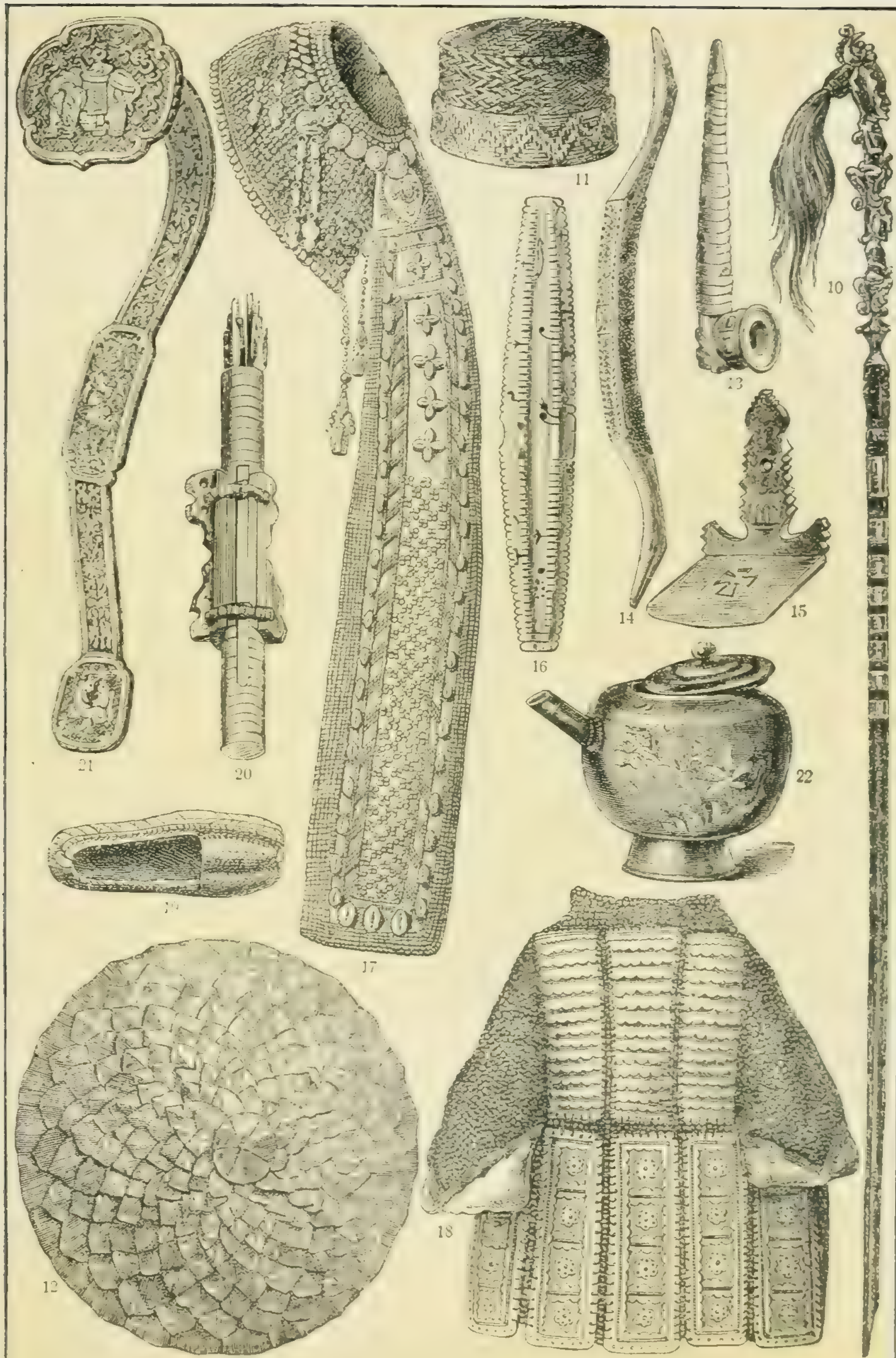
The early religion of the Aryan race,— a nation of shepherds,— divided itself after their separation into two related but widely different developments, Brahmanism and Zoroastrianism. (See INDIA (*Religion*); ZEND-AVESTA.) The former became rich in mythological, theological, and philosophical literature; but historical literature properly so called is wanting, and consequently there is a great absence of certainty with regard to the dates of early events. The war which the Mahâbhârata (see SANSKRIT LANGUAGE AND LITERATURE) professes to narrate is believed to be the earliest event in Indian history that can be regarded as historical, and probably took place about 1200–1400 B.C. In China authentic history extends back prob-

ably to about 1100 B.C., with a long preceding period of which the names of dynasties are preserved without chronological arrangement. The kingdoms of Assyria, Babylonia, Media, and Persia, alternately predominated in southwestern Asia. The arms of the Pharaohs also extended into Asia, but their conquests there were short-lived. From Cyrus (B.C. 559), who extended the empire of Persia from the Indus to the Mediterranean, while his son, Cambyses, added Egypt and Libya to it, to the conquest of Alexander (B.C. 330), Persia was the dominant power in Asia. The administration of Persia was not without vigor and policy, yet the Macedonian conquest was an event of great importance to Asia, bringing it, along with northern Africa, into closer relation with the more advanced and progressive continent of Europe. The division of Alexander's empire led to the protracted struggle between the Greek dynasties of Egypt and Syria, which ended in the absorption of both kingdoms in the Roman empire. After the unfortunate issue of the second Punic war Hannibal took refuge with Antiochus the Great of Syria, who, in the course of his conquests, had come in contact with the Romans, and was at length incited to try his strength with them. In the course of the war with Antiochus L. Scipio, together with his brother, the conqueror of Carthage, passed into Asia. The kingdom of Antiochus was spared after his overthrow; but in B.C. 65 Syria became a Roman province. The Roman empire ultimately extended to the Tigris.

The knowledge of Asia possessed by the Greeks and Romans was at its widest extent very limited. The countries with which they were best acquainted were naturally in the west. China they knew as the country of the Seres or Sinæ, and the northern portions of the continent, inhabited by predatory Mongol tribes, were vaguely designated as Scythia. Of India the northwestern and western parts were known, and Ceylon likewise, under the name of Taprobane. The country traversed by the Hindu Kush, and the sources of the Oxus, was known as Bactria; that between the Oxus and the Jaxartes as Sogdiana; a large and vaguely defined central district, including Persia, was known as Ariana. Ptolemy had some acquaintance with the Indian Peninsula, with the table-land of cental Asia, with the Himalayas (Imaus) and China. The better known countries of the southwest comprised Asia Minor, Armenia, Arabia, Persia, Media, Parthia, Mesopotamia, Babylonia, Assyria, Syria.

Soon after the most civilized portions of the three continents had been reduced under one empire the great event took place which forms the dividing line of history. Christianity spread rapidly in the Roman empire; but Armenia was the first country which received it as a national religion. In A.D. 226 the Parthian monarchy which had arisen in eastern Persia about B.C. 250, and had disputed the empire of Asia with the Romans, was overthrown by the revived Persian dynasty of the Sassanidæ. The empire of Asia was now disputed with the Romans by the Persians. In the revived Persian empire the Magian religion was restored, and after the establishment of Christianity in the Roman empire religious jealousy embittered the feud between the two powers. The possession of Armenia was the subject of a protracted struggle between them; but its religion inclined it to the Roman alliance. The Tigris formed the most permanent boundary between the two empires, neither being able long to maintain any conquests beyond it. Christianity was persecuted in the Persian empire, and could not extend itself freely beyond the Roman limits. After the division of the Roman empire (A.D. 364) the struggle continued between the eastern and the Persian empires until the rise of a new power destined to absorb them both. While the Eastern empire was struggling more and more feebly with the Persians, the Mongols, and the barbarians of Europe, a new religion arose in Arabia (A.D. 622), which gathered around it a band of enthusiasts, small at first, but inspired with the most ardent zeal of proselytism. The central tenet of the unity of God gave them the sympathy of the Monophysite sect, which, persecuted in the empire, was powerful in Egypt, Syria, Mesopotamia, and Armenia. Arabia, the country of the Prophet, soon gave its adherence to the new faith. The sword was consecrated as the instrument of its propagation. Persia was the first great conquest of the Arabians. Syria and Egypt soon fell before their arms, powerfully aided by the defection of the heretics of the empire, and within 40 years of the celebrated flight of Mohammed from Mecca, which constitutes the era of his followers, the sixth of the Caliphs, or successors of the Prophet, was the most powerful sovereign of Asia. Heraclius, one of the most warlike, and in the early part of his reign one of the most successful of the eastern emperors, had succumbed to this torrent of conquest, and his successors trembled at the names of their rivals. The successors of Mohammed were at first austere and simple in their manners, and narrow and zealous in their religious faith; but from the accession of Moawiyah (A.D. 661), the time when the seat of empire was transferred first to Damascus and subsequently to Bagdad, the throne of the Caliphs was as splendid as it was powerful. The generous blood of Arabia, nourished by more genial climes, showed an aptitude for all that is great, not only in military achievement, but in learning, science, literature, and art. The empire was soon divided, but wherever the Arab sway prevailed a liberal patronage of learning and toleration even of speculative inquiry distinguished it. The career of conquest was not soon ended. It spread with astonishing rapidity over Africa and Europe, and was finally checked only by the fatal divisions which originated in the disputes between the descendants of the Prophet and the dynasty of the Ommiades, descended from his mortal foe and tardy convert, Abu Sophian.

Among the alternate protectors and oppressors of the eastern Roman empire were the various Mongol tribes, whose predatory course led them to the west. In these also the Arab rulers found dangerous converts, who first supplied the place of their own troops, grown effeminate with luxury, and then supplanted themselves in the throne of which they had superseded the natural defenders. While the Caliphs of Bagdad still held a nominal sway, subject to the dictation of their Turkish guards, Mahmud, the Mongolian Mohammedan ruler of Ghazni, asserted his independence (999), con-



10. Dancing Staff from Sumatra.
11. Head Covering from Luzon.
12. Hat from Borneo.
13–16. Articles from Samoa and Tongu Islands.
17. Bashkir Ornament.
18. Suit of Armor.
19. Armored Shoe.
20. Aino Quiver.
21. Mandarin's Staff in Red Lacquer.
22. Japanese Water Bottle.

quered India, and established the Mogul dynasty. Another revolt from the empire of Mahmud founded the Seljuk dynasty, which established itself in Aleppo, Damascus, Iconium, and Kharism, and which was distinguished for its struggles with the Crusaders. Othman, an amir of the Seljuk sultan of Iconium, established the Ottoman empire in 1300. About 1220 Genghis Khan, an independent Mongol chief, made himself master of central Asia, conquered northern China, overran Turkestan, Afghanistan, and Persia; his successors took Bagdad and extinguished the remains of the Caliphate. In Asia Minor they overthrew the Seljuk dynasty. His grandson, Kublai Khan, conquered China in 1260. The successors of Genghis Khan also invaded Russia, and the Christian empire established by Vladimir was overthrown by the Golden Horde, led by his grandson Batu (1240). Timur or Tamerlane, who professed to be a descendant of Genghis, carried fire and sword over northern India and western Asia, defeated and took prisoner Bajazet, the descendant of Othman (1402), and received tribute from the Greek emperor. The Ottoman empire soon recovered from this blow, and Constantinople was taken and the Eastern empire overthrown by the Sultan Mohammed II. in 1453. China recovered its independence about 1368 and was again subjected by the Manchu Tartars (1618–45), soon after which it began to extend its empire over central Asia. Siberia was conquered by the Cossacks on behalf of Russia (1580–4). The same country effected a settlement in the Caucasus about 1786, and has since continued to make steady advances into central Asia. The discovery by the Portuguese of the passage to India by the Cape of Good Hope led to their establishment on the coast of the peninsula (1498). They were speedily followed by the Spanish, Dutch, French, and British. The struggle between the two last powers for the supremacy of India was completed by the destruction of the French settlements (1760–65), and from that time the conquest of India by the British progressed with uninterrupted success. In 1858 India came directly under the British crown. The extension of the influence and possessions of European powers, especially Russia, Great Britain, and France, has latterly been a most striking fact in Asiatic history. For particular phases of the modern history of Asia see CHINA; KOREA; JAPAN; MANCHURIA; RUSSIA and TURKEY. Also BOXERS and TRIPLE ALLIANCE.

A'sia, Central, a designation loosely applied to Asiatic territory east of the Caspian, also called Turkestan, and formerly Tartary. The eastern portion belongs to China, the western now to Russia. Russian central Asia comprises the Kirghiz Steppe (Uralsk, Turgai, Akmolinsk, Semipalatinsk, etc.), and what is now the government-general of Turkestan, besides the territory of the Turkomans, or Tanscaspia and Merv. The entire area is about 1,350,000 square miles. See Bouvalot, 'Through the Heart of Asia' (1889); Phibbs, 'Central Asia' (1899).

Asia Minor (Asia the Less) is the extreme western peninsular projection of Asia, forming part of Turkey in Asia. The name is not very ancient; originally the Greeks seem by Asia to have meant only the western part of Asia Minor, but with their geographical knowledge the scope of the name Asia gradually widened. The late Greek name for Asia Minor is Anatolia — *Anatolê,* "the East," whence is formed the Turkish *Anadōli.* Asia Minor includes the peninsula; the eastern boundary, somewhat artificial, being a line from the Gulf of Skanderoon to the upper Euphrates, and thence to a point east of Trebizond. The area of the peninsula exceeds 220,000 square miles. It constitutes the western prolongation of the high table-land of Armenia, with its border mountain ranges. The interior consists of a great plateau, or rather series of plateaus, rising in graduation from 3,500 to 4,000 feet, with bare steppes, salt plains, marshes, and lakes; the structure is volcanic, and there are several conical mountains, one of which, the Ergish-dagh (Argæus), with two craters, attains a height of 11,830 feet, towering above the plain of Kaisarieh, which has itself an elevation of between 2,000 and 3,000 feet. The plateau is bordered on the north by a long train of parallel mountains, 4,000 to 6,000 feet high, and cut up into groups by cross valleys. These mountains sink abruptly down on the northern side to a narrow strip of coast; their slopes toward the interior are gentler and bare of wood. Similar is the character of the border ranges on the south, the ancient Taurus, only that they are more continuous and higher, being, to the north of the Bay of Skanderoon, 10,000 to 12,000 feet, and farther to the west, 8,000 to 9,000 feet. The western border is intersected by numerous valveys opening upon the archipelago, to the northern part of which Mounts Ida and Olympus belong. Between the highlands and the sea lie the fertile coast-lands of the Levant. Of the rivers the largest is the Kizil Irmak (Halys), which, like the Yeshil Irmak (Iris), and the Sakaria (Sangarius) flows into the Black Sea; the Sarabat (Hermus) and Meinder (Mæander) flow into the Ægean.

The climate has, on the whole, a southern European character; but a distinction must be made of four regions. The central plateau, nearly destitute of wood and water, has a hot climate in summer, and a cold one in winter; the southern coast has mild winters and scorching summers; while on the coast of the Ægean there is the mildest of climates and a magnificent vegetation. On the northern side the climate is not so mild, but the vegetation is most luxuriant.

In point of natural history, Asia Minor forms the transition from the continental character of the East to the maritime character of the West. The forest-trees and cultivated plants of Europe are seen mingled with the forms characteristic of Persia and Syria. The central plateau, which is barren, has the character of an Asiatic steppe, more adapted for the flocks and herds of nomadic tribes than for agriculture; while the coasts, rich in all European products, fine fruits, olives, wine, and silk, have quite the character of the south of Europe, which on the warmer and drier southern coast shades into that of Africa.

The inhabitants, some 7,000,000 in number, consist of the most various races. The dominant race are the Osmanli Turks, who number about 1,200,000, and are spread over the whole

country; allied to these are the Turkomans and Yuruks, speaking a dialect of the same language. The latter are found chiefly on the table-land, leading a nomadic life; there are also hordes of nomadic Kurds. Among the mountains east of Trebizond are the robber tribes of the Lazes.

The Greeks and Armenians are the most progressive elements in the population, and have most of the trade. While the Greeks monopolize the professions, the ownership of the land is largely passing into the hands of Greeks, Armenians, and Jews. Administratively the country falls into eight vilayets or governments, with their capitals in Brusa, Smyrna, Konieh (Iconium), Adana, Sivas, Angora, Trebizond, and Kastamuni respectively. In ancient times the divisions were Pontus, Paphlagonia, Bithynia, in the north; Mysia, Lydia, Caria, in the west; Pisidia with Pamphylia, and Cappadocia, in the south; and Galatia with Lycaonia and Phrygia, in the centre. The Turkish islands of the archipelago belong, most of them, to Asia Minor.

Here, especially in Ionia, was the early seat of Grecian civilization, and here were the countries of Phrygia, Lycia, Caria, Paphlagonia, Bithynia, Lydia, Pamphylia, Isauria, Cilicia, Galatia, Cappadocia, etc., with Troy, Ephesus, Smyrna, and many other great and famous cities. Here, from the obscure era of Semiramis (about 2000 B.C.) to the time of Osman (about 1300 A.D.), the greatest conquerors of the world contended for supremacy; and here took place the wars of the Medes and Persians with the Scythians; of the Greeks with the Persians; of the Romans with Mithridates and the Parthians; of the Arabs, Seljuks, Mongols, and Osmanli Turks with the weak Byzantine empire. Here Alexander the Great and the Romans successfully contended for the mastery of the civilized world. But notwithstanding all these wars the country still continued to enjoy some measure of prosperity till it fell into the hands of the Turks, under whose military despotism its ancient civilization has been sadly brought to ruin. Recently, considerable portions of Armenia have been absorbed by Russia. In 1878 Great Britain made a secret engagement to guarantee against Russian aggression the Asiatic dominions of the Porte.

In Asia Minor an extensive system of railroads has long been under consideration. The first survey for this proposed trunk line was made as far back as 1874, and was from Angora to Bagdad. The financial crisis of 1875 resulted, however, in the abandonment of the scheme, but it was again considered in 1888 by foreigners interested in railroad enterprise in Asia. The Suitari-to-Angora line was conceded in October of that year to the Bank of Berlin, and on 27 Nov. 1892 the first train was run. A branch line was shortly after built between Eski-Schehir and Konia and connected with the line to Smyrna. The success of this undertaking influenced the Sultan's desire to have the line extended to Bagdad across Mesopotamia, and the German syndicate was instructed accordingly. The survey was made in the winter of 1899–1900 by a commission under the presidency of the German consul-general at Constantinople. Matters were hastened by the request of the Emperor William that the work be pushed forward as rapidly as possible.

Asiarch, ä'shī-ärk, a Roman officer appointed as director-general of religious ceremonies in the province of Asia. The expression occurs in the Greek Testament, *Tines de kai tōn Asiarchōn,* "And certain also of the Asiarchs" (Acts xix. 31). Properly speaking there was but one Asiarch residing at Ephesus; the others referred to were his subordinates.

A'siat'ic Broth'ers, the designation of a secret society organized in Germany about 1780. See ROSICRUCIANS.

A'siat'ic Societies, learned associations formed for the purpose of collecting and disseminating valuable information respecting the different countries of Asia. The Royal Asiatic Society of Great Britain and Ireland was established 19 March 1823. With it in 1828 was connected a very active translation committee, which publishes English, French, and Latin translations of Oriental works, occasionally accompanied with the originals. Similar societies have been formed in Asia itself, such as the Asiatic Society of Bengal at Calcutta, founded in 1784 by Sir William Jones. Since 1846 the Bibliotheca Indica,— a series of Oriental works in text and translation,— has been published under the supervision of this society at the expense of the Anglo-Indian government. There are similar societies on the Continent and in America, such as the Société Asiatique at Paris, founded in 1822, the Oriental Society of Germany (Deutsche Morgenländische Gesellschaft), founded in 1845, and the American Oriental Society.

Asimina, a-sĭm'ĭ-na, or ăs'ĭm-ĭ-nă, **Papaw,** a genus of nine species of shrubs or small trees of the natural order *Anonaceæ,* eight of which are natives of eastern North America, the West Indies, and Mexico, with attractive foliage and large purple or whitish axillary flowers appearing in early spring, and large edible berries. Two species are cultivated for ornament and deserve more attention at the hands of horticulturists. One of these, *A. triloba,* which has produced some varieties, is the only arborescent species of the genus. It is hardy as far north as Massachusetts and produces very large seeded fruits, often more than three inches long and too highly aromatic to suit all palates. The other species, *A. grandiflora,* is found in Georgia and Florida, and is said to produce delicious fruits.

A'siphona'ta, an order of lamellibranchiate, bivalve mollusks, destitute of the siphon or tube through which, in the Siphonata, the water that enters the gills is passed outward. It includes the oysters, the scallop shells, the pearl oyster, the mussels, and in general the most useful and valuable mollusks.

Ask, in Scandinavian mythology, the name of the first man created. According to the legend, the gods, Odim, Hæner, and Loder, found two trees by the seaside, an ash and an elm. From these they created the first man and first woman, Ask and Embla, and gave them the earth as their dwelling place.

Askew, ăs'kū, **Anne,** an English martyr: b. 1521; d. 16 July 1546. She is described as a lady of great beauty and learning, married, much against her inclinations, to Thomas Kyme, who was as attached to the old religion as she was to the new. She was arrested for heresy

and led before Bonner, Bishop of London, who induced her to sign a recantation. She was again arrested, however, committed to Newgate, and condemned to death as a heretic. Some days later she was suddenly removed to the Tower, and the rack was applied in the presence, and it is said even by the hands, of Wriothesley, the chancellor, who hoped to extort confession concerning those ladies of the court with whom she corresponded. Before her frame had time to recover from the effects of the rack she was carried in a chair to Smithfield, chained to a stake, and along with four others was burned to death.

Askhabad, äs'ka-bäd', the thriving administrative centre of the Russian province of Transcaspia, situated in the Akhal Tekke oasis, and occupied by Skobeleff in January 1881, after the sack of Geok Tepé. Its distance from Merv is 232 miles, from Herat 388 miles. Pop. (1897) about 20,000.

Askja, äsk'ya, a volcano in the centre of Iceland, first brought into notice by an eruption in 1875. Its crater is 17 miles in circumference, surrounded by a mountain-ring from 500 to 1,000 feet high, the height of the mountain itself being between 4,000 and 5,000 feet.

Aslauga's (a-slow'găz) **Knight,** the title of a romantic tale of mediæval chivalry, by Fredrich, Baron de la Motte, Fouqué. It was published in 1814. The story is told with simplicity and grace, and with it may be compared 'The Fostering of Aslang' in Wm. Morris' 'Earthly Paradise.'

Asmai, äs'mī, or **Asmayi,** an Arabic writer, the instructor of Harun-al-Raschid: b. about 740; d. 830. His history of the kings of Arabia and Persia, prior to Islam, is of great value, while his romance of 'Antar' has been called "the iliad of the desert."

As'manite, a variety of silica, occurring in small grains in certain meteoric irons, and now believed to be identical with tridymite (q.v.).

Asmannshausen, äs'mans-how'zĕn, a Prussian village on the Rhine, in the district of Wiesbaden, below Rüdesheim, celebrated for its wine, which is produced on a soil formed of blue slate. The red kind, the production of a small red Burgundy vine, is the more valuable, but retains its value only three or four years. After this time it grows worse every year, and precipitates the whole of its red coloring-matter. It is distinguished by color and taste from all other Rhenish wines.

As'mode'us, or **Asmo'dai,** in Hebrew mythology, an evil spirit which slew seven husbands of Sara, daughter of Raguel, at Rages. By the direction of the angel Raphael the young Tobias exorcised Asmodeus with the smell of a fish's liver burned on the coals, into the uttermost parts of Egypt, where the angel bound him.

As'mode'us, The Lame Devil ('Le Diable Boiteux'). A novel by Alain René Le Sage, first published in 1707, and re-published by the author, with many changes and additions, in 1725. It is sometimes known in English as 'Asmodeus,' and sometimes as 'The Devil on Two Sticks,' under which title the first English translation appeared, and was dramatized by Henry Fielding in 1768.

As'monæ'ans, a family of high-priests and princes who ruled over the Jews for about 130 years, from 153 B. C. See MACCABEES.

Asmus, äs'mŭs, **Georg,** a German-American poet: b. Giessen, 27 Nov. 1830; d. Bonn, 31 May 1892. He came to the United States to conduct some mining operations in the copper region of Lake Superior; then lived in New York until 1884, when he returned to Europe. Among the German population of the United States he had an enormous success with his 'American Sketch-Booklet' (1875), an epistle in verse, written in Upper Hessian dialect and overflowing with delicious humor. It was followed by 'New American Sketch-Booklet' (1876). He also wrote 'Camp Paradise' (1877), a story, and a collection of miscellaneous poems (1891).

Asnieres, as-nyār, a northern suburb of Paris, a favorite boating resort with the Parisians. Pop. (1897) 24,317.

Asnyk, äs'nek, **Adam,** a Polish patriot and poet: b. Kalish, 11 Sept. 1838; d. Cracow, 2 Aug. 1897. He participated in the insurrection of 1863, for which he had to spend some years in exile in Germany. He was author of 'Poezye,' (1872–80), and several successful dramas.

Asoka, a-sō'ka, an Indian sovereign, who reigned 255–223 B.C. over the whole of northern Hindustan. He embraced Buddhism, and forced his subjects also to become converts. Many temples and topes still remaining are attributed to him.

Aso'ka (*Jonesia asoca*), an Indian tree, of the natural order *Leguminosæ*, sub-order *Cæsalpineæ*, with a flower, showing orange, scarlet, and bright-yellow tints. It is sacred to the god Siva, and often mentioned in Indian literature.

As'olan'do: Facts and Fancies, the latest volume of poems written by Robert Browning and published on the day of his death, 12 Dec. 1889.

Aso'pus, the name of several rivers in Greece. The most celebrated of this name are those in Achaia and Bœotia.

Asp, a venomous snake. The name as applied in the Bible probably refers to the hooded, or African cobra (*Naja haje*), common in Egypt, and often represented in hieroglyphics. The naja haje is from three to five feet long, and the loose skin on its neck can be dilated into a hood, like that of the Indian cobra, but its markings differ. (See COBRA.) The asp employed for suicide by Cleopatra was probably the small-horned viper (*Aspis hasselquistii*). The asp of southern Europe is *Vipera aspis,* found from France to the Tyrol and in Italy. (See VIPER.)

Asparagin, Asparagine, a nitrogenous substance having the formula $C_4H_8N_2O_3$, or $CONH_2.CH_2CH\ (NH_2).COOH$, occurring in the juice of most plants, and notably in the growing buds of asparagus. It is readily obtained by filtering the plant juice, and evaporating it to a syrupy consistency. The asparagin then separates in the form of trimetric prismatic crystals, which are soluble in water and in acids and alkalis, but insoluble in alcohol or ether. Asparagin undoubtedly plays a very important (though yet

unknown) part in the chemistry of plants, since it occurs in large amounts in germinating seeds, and wherever growth is actively proceeding.

Aspar'agus, a genus of about 150 species of mostly tuberous-rooted, climbing, drooping, trailing, or erect perennial herbs or shrubs widely distributed in tropical and warm temperate countries, especially in southern Europe and southern Africa, but more or less cultivated for food or ornament in all civilized countries. Some species rival and even excel the most delicate ferns in beauty of habit and foliage, which botanically considered, consists not of leaves but leaf-like stems. The ornamental species with the exception of *A. verticellatus* (see below), must all be grown in green-houses, except in southern Florida and southern California, where they may be planted with safety out of doors. They are readily and usually propagated by seeds, but often also by cuttings and by division. Among the best-known ornamental species cultivated in America are the following: *A. medeoloides*, also known as *Myrsiphyllum asparagoides*, the smilax of the florist, is widely grown for decorative purposes, for which its glossy green leaves specially commend it. (For culture, see SMILAX). *A. sprengeri*, a species recently introduced from Natal, with long drooping branches, glossy light-green leaves (white in one variety); small white fragrant flowers in small racemes and little red berries. It is very popular, especially for planting in hanging baskets. *A. plumosus*, a tall climbing species from South Africa with horizontal branches of beautiful form, texture and color, which qualities are retained for weeks or even months after cutting. Deservedly one of the most popular of decorative plants. It has developed several varieties, some of which, especially the variety *tenuissimus*, are even more popular than the original species. *A. verticellatus*, a hardy species with tufts of hair-like leaves and small red berries, is a native of Persia and Siberia, and climbs to a height of 12 to 15 feet from a woody root stock. The stout young shoots are said to be edible, but they quickly become woody and spiny, and are then unfit for the table. Several other species are cultivated for ornament in America.

Best and most widely known, however, is *A. officinalis*, esculent asparagus, which is also used to some extent as an ornamental plant. It is a perennial herb, native of Europe and Asia, and commonly found growing in sandy loam or sea shores, river banks, and among shrubby undergrowth. In a wild state it rarely exceeds a foot in height and a stem diameter of more than one third of an inch; but in gardens sprouts are sometimes obtained as thick as a man's wrist, and the plants often grow more than four feet tall. For more than 2,000 years it has been cultivated for its succulent young shoots, produced from the thick root stocks in spring. An excellent method of growing the plant may be epitomized as follows:

The land chosen for the bed should be a rich, friable and warm loam, preferably exposed to the south or east. Manure should be applied without stint before the plants are set, and the preparation of the soil should be deep and thorough. The plants may be home-grown or purchased. One-year-old plants, if sturdy, are preferable to older ones. For home growing a separate nursery bed should be prepared, and the seed previously soaked 24 hours in order to hasten germination, when sown in early spring, about two inches apart and one inch deep, at which rate an ounce should be enough for 200 or more feet of drill. Some radish seed of a small early maturing variety should be sown in the same drill, so that the young radish plants, which quickly appear, may mark the position of the rows of the slower-appearing and less-conspicuous asparagus plants. As soon as the radishes are of edible size, or even before, if necessary, they should be pulled and the asparagus plants, then an inch or two tall, left in possession of the ground. Beyond keeping down weeds, destroying pests, and thinning the plants to four inches asunder, no further attention is necessary during the first year. In the spring of the second year, if properly managed during the first, the plants should be large enough to be transplanted to the permanent bed. If too small they should be transplanted at least eight inches asunder, and grown a second year in a nursery bed. In the permanent bed the plants should stand at least two feet asunder in rows not less than four feet apart. Five or even six feet for the larger growing varieties is much better. Staminate plants are more productive of shoots than pistillate, but are difficult to recognize until the plants flower. The furrows are plowed six inches deep or deeper, the plants set in the bottom, but at first covered with only about two inches of earth. After growth starts the trench is gradually filled by cultivation which must be thorough, both among the plants and between the rows. Not before the second spring after planting in permanent quarters should any shoots be gathered. At the time of planting a liberal dressing of some slowly decomposing fertilizer, such as ground bone, should be given in the drill, and in the spring of each year complete fertilizers should be applied liberally. (See FERTILIZERS.) In addition to such applications many growers spread stable manure upon the bed in the autumn after the tops have been removed, a necessary practice to prevent the scattering of the seeds upon the bed. In the spring as soon as the soil can be worked the land is either plowed shallow or cultivated deeply to bury the manure. Since the plants are gross feeders there need be little fear of fertilizing too heavily. Methods of gathering depend somewhat upon whether the stalks are to be blanched or left green. Blanching is done by ridging the soil 13 inches deep above the crowns. Stalks so produced are gathered as soon as the tips appear above the soil; green stalks are cut when about nine inches long, including the base of two or more inches below the surface of the ground. In each case the stalk may be cut with an asparagus knife or preferably snapped near the crown, or at least at the proper depth, if blanched, by plunging the hand down in the loose soil beside the stalk and severing it with the fingers. By the latter method there is less danger of injuring other shoots. All cutting should cease when green peas, grown in the same locality, are ready for the table, because the plants must be given opportunity to store up food for the following year. The stems are usually sold in bunches of various sizes, the grade depending upon the length and

number of stalks in the bunch. The bunch commonly sold is eight and one half inches long, weighs about two pounds, and contains 30 spears. As a rule, the thicker the spear the better. First class spears are three quarters of an inch thick or thicker. Every care must be taken in handling to prevent bruising, since a gummy juice collects in the broken cells, and the injured stalks spoil by heating. After washing, the stalks should be dried and kept cool. If to be shipped long distances, their butts should rest in damp sphagnum moss or similar material. In the home garden, where horse cultivation is not practicable, the plants may be set even as close as 18 inches by two feet, but the manuring, cultivation and other care must be increased in order to obtain choice shoots. Each spring the very liberal dressing of manure applied the previous autumn should be forked, not dug, in, and a lavish amount of commercial fertilizer, rich in potash, phosphoric acid, and nitrogen, applied. Soap suds may be emptied upon the bed; they have more or less potash in them. Asparagus sometimes is forced in hot beds, under greenhouse benches, in cellars, etc., by setting mature crowns (plants) close together and supplying heat and moisture. A large amount of light is not essential. It is also forced in the field by covering the beds with cloth and applying heat by means of portable steam pipes, either in or upon the ground. In the former case the roots are ruined by the process; in the latter, they are not, but should be given one or more years to fully recuperate. (See reports and bulletins of Cornell Experiment Station and of Missouri Experiment Station). Several other species furnish edible shoots; for example, *A. acutifolius, A. albus* and *A. tennuifolius,* all European species. The tubers of *A. lucidus* are eaten in China and Japan, where the species is indigenous. The shoots of *A. scaber,* which resemble those of *A. officialis,* are inedible because bitter.

Enemies.— Asparagus has only two important enemies, and when compared with other general crops, long cultivated, only a few less serious ones. Asparagus rust (*Puccinia asparagi*) has been known for about 100 years, but only during the last decade of the 19th century did it do serious damage. In a badly infested field the plants as a whole seem to be maturing very early, their deep green having been replaced by a tawny brown. The stems examined closely, show a blistered and ruptured skin, beneath which are brown masses of spores or in late autumn, almost black winter spores. In the spring the «cluster cup» is the form observed. The most effective control is the resin-Bordeaux mixture, made by adding to each 48 gallons of standard Bordeaux mixture two gallons of resin stock solution, made as follows: Heat five pounds of resin and one pint of fish-oil in a kettle until the resin is dissolved. If very hot, allow to cool somewhat. Then slowly stir in one pound of potash lye and heat again till the mixture becomes the color of amber, when five gallons of water must be added. If the potash be added while the resin is too hot, the mixture may ignite. This solution increases the adhesiveness of Bordeaux mixture. (See FUNGICIDE.) With the mixture 50 per cent greater yield has been obtained in unfavorable seasons, and 70 per cent in favorable. Growers cutting 800 bunches or more per acre find that thorough spraying each week for four, five or even more weeks pays well. For detailed account of this disease and specific methods of control, see New York Experiment Station Report (1901). The asparagus beetle (*Crioceris asparagi*), a European insect introduced about 1856, the only seriously injurious insect pest, is about one quarter of an inch long with black and yellow or red wing-covers. It belongs to the *Chrysomelidæ.* It appears as the adult in spring, and lays eggs on the shoots. In a few days grayish-green grubs appear and gnaw the green parts of the plants. When full grown they burrow in the ground to pupate for a short time. The broods succeed each other at intervals of about a month, if the weather be favorable. Their natural enemies are lady-bird beetles and soldier beetles. The popular remedies are the corralling of chickens, ducks, and turkeys in the plantation; cutting all volunteer plants in waste places; cutting new shoots daily; allowing spindling shoots to remain in alternate rows for the insects to deposit their eggs upon and burning the shoots not less often than once a week; dusting with air-slaked lime or road dust while the dew is on; brushing the grubs to the hot ground from the full grown plants, the middle of the day being chosen for this operation; spraying with arsenites, hellebore or other stomach poisons; etc. A case of fight early and fight late! The 12-spotted asparagus beetle (*Crioceris 12-punctatus*), about the same size as its relative just described, but orange red with black dots, has a similar life history, and may be controlled in the same way but is not yet seriously troublesome, except in a few localities. Several plant bugs, moth larvæ, beetles and aphids also feed upon asparagus, but have not become serious pests. Consult: Year-book United States Department of Agriculture (Washington, 1896), and Bulletin No. 10 (1898). See INSECTICIDES.

For fuller details of asparagus culture consult: Hexamer, 'Asparagus Culture' (1901); Bailey and Miller, 'Cyclopedia of American Horticulture' (1900–02). In the latter will also be found specific instruction for the cultivation of ornamental asparagus.

Asparagus-stone, a variety of apatite, found in Murcia, Spain, in the form of small, transparent, yellowish-green crystals.

Aspasia, ăs-pā'shĭ-a, a celebrated woman of ancient Greece: b. in Miletus in Ionia, but spending a great part of her life in Athens. Her house was the general resort of the most virtuous, learned, and distinguished men in Greece. She inspired the strongest and most enduring affection in the heart of Pericles, who had separated from his own wife and united himself to Aspasia as closely as was permitted by the Athenian law, which declared marriage with a foreign woman illegal. When the Athenians were dissatisfied with Pericles, instead of attacking him they persecuted the objects of his particular favor, and accused Aspasia of contempt of the gods. Pericles defended her in the Areopagus, but it required all his influence to procure her acquittal. After his death (B.C. 429) Aspasia is said to have attached herself to a wealthy but obscure cattle-dealer, of the name of Lysicles, whom she soon made, however, an influential

citizen in Athens. She had a son by Pericles, who was legitimated by a special decree of the people.

As'pect, a term in astronomy and astrology, denoting the situation of the planets and stars with respect to each other. There are five principal aspects: (1) sextile aspect, when the planets or stars are 60° distant, and marked thus, *; (2) the quartile or quadrate, when they are 90° distant, marked □; (3) trine, when 120° distant, marked △; (4) opposition, when 180° distant, marked ☍; and (5) conjunction, when both are in the same degree, marked ☌. Kepler added eight more. It is to be observed that these aspects, being first introduced by astrologers, were distinguished into *benign, malignant,* and *indifferent;* and Kepler's definition of aspect, in consequence, is "Aspect is the angle formed by the rays of two stars meeting on the earth, whereby their good or bad influence is measured." The aspects now in use are conjunction, opposition, and quadrature.

As'pen, Col., a city and county-seat of Pitkin County, on the Roaring Fork of Grand River, and the Colorado Midland, and the Denver & R. G. R.R.'s; 30 miles west of Leadville. It was incorporated in 1883; and has since become the centre of one of the richest mining sections in the country. In the city and vicinity are more than 20 mines, for which there are a number of silver, zinc, and lead ore mills. While the smelting and concentrating of ores is the distinctive industry, the city has several minor factories, and it is also the principal mining trade centre of the Roaring Fork Valley. Pop. (1900) 3,303.

As'pen, tremulous poplar, a tree of the order *Salicaceæ* and genus *Populus*, native of the cooler parts of Europe and Asia, and succeeding best upon moist, gravelly soils. It grows quickly; usually attains a height of 50 to 60 feet, sometimes even 100 feet; has light, small, thin-toothed leaf-blades upon long, slender, flattened petioles which permit the blade to flutter with the least breeze, hence the specific name *P. tremula*, tremulous. The wood being white, light, soft, and porous, is not a valuable fuel, but is useful for making charcoal for the manufacture of gunpowder, and for turning, often being employed for making bowls, trays, troughs, and pails. The wood may be made harder and thus rendered useful for interior work in houses by peeling off the bark and allowing the stem to dry before felling it. In places where this tree abounds, and other timber is scarce or expensive, this method of hardening is very useful. The bark is rich in a glucoside called salicin and used in leather tanning. In the United States the tree is best known as an ornamental one, its variety, *pendula*, with graceful drooping sprays, being perhaps the best weeping poplar. The male plants are preferred because of the abundance of their catkins which appear in early spring before the catkins of American species blossom. The American aspen (*Populus tremuloides*), very generally distributed from Alaska to Labrador and southward to Pennsylvania and California, and, in the mountains to Mexico, so closely resembles the preceding species that many botanists consider it merely a variety. Its light-gray branches render it conspicuous in clearings where it is one of the first trees to appear. It is said to attain a height of 100 feet when grown in the forest. This tree, like the following, is widely used in the manufacture of wood pulp. The large-toothed aspen (*Populus grandidentata*) is a large American species found from Nova Scotia to Minnesota and southward to Tennessee. It is a tall tree, often reaching 75 feet, and has bluish or rusty-white leaves thicker and larger and with more spreading teeth than the former two species. Except its drooping varieties, it is rarely used as an ornamental tree. See POPLAR.

Aspern, äs-pern, and **Esslingen,** two villages a few miles east of Vienna, on the opposite bank of the Danube, celebrated for the battle fought 21 and 22 May 1809, between the Archduke Charles and Napoleon I. After the fall of the capital the Austrian general resolved to suffer a part of the enemy's forces to pass the Danube, and then to surround them with his own army and drive them if possible into the river. Everything depended on the possession of these two villages: Aspern was at first taken by the Austrians, again lost and retaken, till they at length remained masters of it: from Esslingen they were continually repulsed. The battle was renewed on the 22d; the French army being now increased so as at least to equal the Austrians in number. Thousands of lives were sacrificed in vain attempts to capture the villages. Aspern continued to be the stronghold of the Austrians and Esslingen of the French. When the army of Napoleon gave up all hopes of gaining the victory by forcing the centre of the Austrians, Esslingen served to secure their retreat to the island of Lobau. The loss of the Austrians in killed, wounded, etc., was estimated at less than a third of the whole army; that of the French at half. The latter lost on this occasion Marshal Lannes. The Austrians had 4,000 men killed and 16,000 wounded, the French 8,000, 30,000 wounded. By the French the engagement is known as the battle of Essling or Esslingen, but the Austrians style it the battle of Aspern.

Asphalt. The general term asphalt is applied to the several varieties of hydrocarbons of an asphaltic base which exist in all conditions from the liquid to the solid state. It is more specifically employed to include the purer forms of hard and soft bitumen, such as elaterite, albertite, gilsonite, nigrite, wurtzilite, brea, etc. The term bituminous rock includes sandstones and limestones impregnated with bitumen or asphalt. This rock, usually shipped without previous refining, is used principally for street pavements and is mixed with other ingredients at the place of use.

The importation of asphalt into the United States is chiefly from the Island of Trinidad, off the coast of Venezuela. Other imports are made from Bermudez and Venezuela. Bituminous limestones are imported from Neuchatel and Val de Travers, in Switzerland, from Seyssel in France, and in small quantities from Germany, Italy, Russia, Austria-Hungary, Spain, Turkey in Asia, Great Britain, the United States of Colombia, Canada, the Netherlands, Cuba, and Mexico. The total imports from Trinidad and Venezuela in 1900 amounted to 134,189 long tons, and at the present time the value of our

domestic product is about equal to that of the imported asphalt, at the point of shipment. The Island of Trinidad, one of the British West Indian possessions, is, next to France, the largest producer of asphalt in the world. The deposits are operated by an American corporation under a concession from the British government, and, also, independently, from land not belonging to the crown, acquired by purchase. The chief source of supply is a lake of pitch filling the crater of an extinct volcano. This lake lies 138 feet above sea-level, and has an area of about 114 acres. The supply is partly renewed by a constant flow of soft pitch into the centre of the lake from subterranean sources. The shipments of this lake pitch average over 80,000 tons per year, and the flow into the lake is at the rate of about 20,000 tons per year. The depth of this lake is about 135 feet at the centre. Distinct from the lake pitch is what is known as "land pitch," the overflow in past times of pitch from the lake, and deposits of similar nature. During recent years strenuous efforts have been made to discredit all asphalt mined from properties located outside of Pitch Lake. These efforts seem to have failed, however. Careful analyses of samples of asphalt taken from different parts of Pitch Lake, from deposits outside the lake and from the district of La Brea show that these asphalts are so similar in composition that for practical purposes they may be considered as identical in quality. The samples have a common origin, for the presence of mineral matter in these asphalts cannot be regarded as adventitious, since it is thoroughly incorporated with the bitumen in the same proportion and has the same percentage of composition, as regards the relative proportions of matter soluble in water, in acids and insoluble substances. There is no doubt that the pitch found in the deposits outside the lake has been divided from the lake itself by the subterranean flow of pitch to the viscous condition, a condition rarely assumed under the combined influence of heat and pressure. It is true there is a difference in the crude materials in these asphalts; one is softer than the other, because of containing more volatile oils. Nature simply began on the asphalt outside the lake; it being more exposed to the rays of the tropical sun, the process of refining it drove those volatile oils off, a necessary accomplishment to make the material fit for paving purposes. It would appear, therefore, that a part of the labor of refining has been done on the land or overflow asphalt which remains to be done with the lake asphalt.

In 1875 the asphalt paving industry was in its infancy in the United States. In 1903 there were about 42,000,000 square yards of asphalt, sheet and block, which has been laid at a cost of about $110,000,000. These pavements are frequently called bituminous pavements, inasmuch as bitumen is the largest constituent of the asphalt, frequently running as high as 9 per cent. Asphalt is manufactured into a cement by mixing it with other forms of bitumen, and this cement is in turn used to bind together particles of sand and limestone in the asphalt pavement. No two asphalts are alike. The life of the pavement depends upon the crude bitumen used, the skill in its manufacture into bituminous cement, the proper proportioning and mixing of the cement with the sand and dust and in the selection of the mineral aggregate.

In 1870, Prof. E. J. Smedt, a Belgian chemist, laid the first sheet asphalt pavement in this country, in Newark, N. J. Prior to this date, coal tar had been used as the cementing material, but with little satisfaction. In 1876 Congress appointed a commission, consisting of Gens. Horatio G. Wright and Quincey A. Gilmore, of the corps of engineers, and Edward Clark, architect of the capitol, to select the best pavement for Pennsylvania Avenue in Washington. Forty-one proposals, for stone, macadam, tar and asphalt pavements, were received. The commission selected two, and decided to use Neuchatel rock asphalt, and De Smedt's artificial Trinidad mixture, in the proportion of two to three. The artificial Trinidad mixture has been most satisfactory. When it was decided, in 1889, to repave Pennsylvania Avenue in Washington, the entire avenue was relaid with it, and the Neuchatel was discarded.

Trinidad Pitch Lake has furnished over 85 per cent of the asphalt used in the United States. The liquid asphalt passing through clay saturates it or carries it in suspension and becomes a brown, earthy, non-viscous substance, chemically composed as follows:

Bitumen	47 per cent
Infusorial earth	28 per cent
Water	25 per cent

The water is evaporated in refining and the residue (approximately one third clay and two thirds hard asphalt) regains some of its viscosity and requires the admixture of some flux or softening agent to give it the proper consistency for paving operations. Samples taken at 100 and 150 feet deep at the centre of Pitch Lake do not differ in composition from those taken on the surface near the shore, showing the homogeneousness of the entire mass. The surface is in constant motion, and gradually lowers as the asphalt is removed. Refined asphalt is shipped from Trinidad to Mexico, South America and other foreign countries; but, owing to the very high duty on refined asphalt coming into the United States, it is cheaper to refine here.

In 1892, the New York and Bermudez Company began the importation of a very pure and hard asphalt from a deposit in the State of Bermudez, Venezuela, and up to the present time about 3,000,000 square yards of pavement have been laid with this material. The Bermudez Asphalt Lake, covering an area of about 1,000 acres, lies about 20 miles from the Gulf of Paria, in a straight line. There are many springs of soft asphalt or maltha, the largest being about 7 acres in area. Outside of the springs, where new material is constantly exuding, the surface of the lake is covered with vegetation and trees, which must first be cut off to reach the asphalt. The quality of the asphalt varies from maltha or liquid asphalt exuding from the springs, to a hard glance pitch. The crude Bermudez asphalt contains on an average about 31 per cent of water, which is present as a mixture and not as an emulsion, and about 66 per cent of bitumen. This asphalt is softer and more brittle than Trinidad, but possesses all essential cementitious qualities.

As early as 1879 asphalt found in Southern California was laid at an intersection on Market Street, San Francisco, which is the heaviest traveled street in that city. In 1884 the late Jesse Warren reported on these California

asphalts, the only indications of which were slight surface exudations of liquid asphalt and large banks of bituminous sandstone (sand saturated with asphalt). In 1895, the Alcatraz Company successfully laid two streets in New York city and acquired a high standing for the California product which was subsequently controlled by the Asphalt Company of America. It has been laid in many Eastern cities, under the trade name of "Alcatraz," "Standard," "Ventura," etc., and has been uniformly successful when refined, mixed and laid intelligently, by men experienced in handling asphalt in all its stages. Shortly after the organization of the Asphalt Company of America, beds of very pure, high grade, liquid asphalt were discovered in Southern California. This being a nearly pure, viscous bitumen, it does not require a softening agent or flux, nor the admixture of other bituminous material, to make it of the proper consistency for paving.

Asphalt Painting. Asphalt was once largely used in painting, especially in the old Dutch school. It was dissolved in spirits of wine to ensure greater permanence. Because of its unreliability it ceased to be used.

Asphalt Process, a photographic process devised about 1814 by J. N. Niepce (q.v.). He coated a plate of polished metal with asphalt varnish, and then placed it with a drawing in a camera obscura for from 4 to 6 hours. The parts of the asphalt which had been acted upon by the light became insoluble. The parts of the asphalt film that had been protected were dissolved by essential oils, and thus a copy of the drawing was brought out. The "heliographs" thus made were not particularly successful. This method has been modified in the asphalt process of photo-mechanical printing. See PHOTO-ENGRAVING.

Asphaltic Coal, coal-like substances which though they have sometimes been classified as coals, differ from all the true coals in respect to both their geological position and their composition. They do not occur in strata, but occupy cavities and fissures, into which they appear to have flowed when plastic. They have been found in Devonian, Carboniferous, and Tertiary rock. The regions in which they are principally mined are Albert County, New Brunswick (albertite), the Uinta Mountains, Utah (gibsonite and uintahite), and Colorado, West Virginia, Texas, and Mexico (grahamite). Wurtzilite is found also in Utah. Their chief uses are as a basis for varnishes, and as insulators. Consult: Blake, 'Uintahite, Albertite, etc.'; 'Transactions' of the American Institute of Mining Engineers, Vol. XVIII. (1890).

As'phodel, a small genus, *Asphodelus,* of hardy annual and perennial fleshy-rooted herbs, natives of the Mediterranean region, belonging to the natural order *Liliaceæ,* but by some botanists made the type genus of the natural order *Asphodelæ. A. luteus, lutea,* king's spear, or yellow asphodel, the true asphodel of the ancients, attains a height of two to four feet, has numerous long (3 to 12 inches) narrow rough-margined leaves which embrace the stem, and in early summer yellow flowers in long racemes (6 to 18 inches), and large persistent membranous bracts. *A. albus,* branching or white asphodel, which has radical leaves, blossoms about the same time as the preceding species, and produces its white funnel-shaped blossoms in branched clusters. Both species are readily propagated by division and are of easy cultivation in any soil. They thrive fairly well in partial shade, but do better when more or less exposed to the sun. *A. ramosus,* a species which by some botanists is made to include *A. albus* and many other species, is cultivated in Algeria and some other countries for its starchy roots which are used to make alcohol. The refuse from this manufacture, together with the leaves and stems, is employed in paper and cardboard-making. Several other related plants are often called asphodel, among which are *Narthecium ossifragum,* bog asphodel, common on European moors; *N. americanum,* by some botanists considered a form of the preceding, and *A. californicum,* similarly called in America. False asphodel is a name given to several species of *Tolfiedia.* The asphodel of the poets is *Narcissus pseudo-narcissus.*

Asphyxia, etymologically, pulselessness, but literally a condition of partial or complete loss of consciousness because of defective oxidation of the blood. The symptoms may be developed rapidly or slowly. In sudden occlusion of the air passages, such as caused by a foreign body in the larynx, or compression of the throat as in hanging, there is usually a quiet period of from 20 to 30 seconds after which respiratory movements, both of inspiration and of expiration, follow. These gradually increase in frequency and depth until in about a minute powerful expiratory convulsions occur; convulsive movements of inspiration are also produced, but these are usually milder in character. A period of exhaustion sets in, the respiratory movements become slower and more irregular, and gradually cease. During this period the face has become pallid, and then deeply cyanosed and flushed, the lips blue to purple, and the body temperature, at first increased, gradually diminishes. The blood pressure is at first increased, and then falls gradually to zero. Unconsciousness develops about a minute after the occlusion, although there is great individual variation, the sphincters relax and the urine and fæces are passed. There is a loss of muscle-tone, and the reflexes are abolished. In asphyxia both lack of oxygen and increase of carbonic-acid gas in the blood are important factors. Asphyxia may result from an excess of carbonic-acid gas with a normal amount of oxygen, and may be produced, if the amount of oxygen is diminished one half, with no variation of the carbon dioxide. For treatment, see DROWNING.

As'pic, a dish consisting of a clear, savory meat jelly, containing fowl, game, fish, etc.

Aspid'ium, a widely distributed genus of ferns, numbering upward of 500 species, of which more than a dozen are found in the United States, including the male and shield ferns. Their only economic use is in medicine. The active principles in this and allied species are filicic acid, aspidin and other phloroglucin-like bodies. The action is largely on the tapeworm, for which parasite this drug is given. Poisonous symptoms sometimes are produced. These are pain, muscular weakness, purging, collapse, and even death. Temporary blindness has been produced by male fern.

As'pinwall, William, an American physician: b. Brookline, Mass., 23 May 1743; d. 16 April 1823. He studied medicine in Philadelphia, and practised in his native town. He served as surgeon with the Revolutionary army, and later became interested in the subject of vaccination and established that preventive in American practice.

As'pinwall, William H., an American constructor of railroads: b. New York city 16 Dec. 1807; d. 18 Jan. 1875. He was for many years a partner in a large shipping firm in New York, but retiring from it in 1850, turned his attention to building the Panama Railroad, whose eastern terminus of Aspinwall is named in his honor. He was likewise prominent in forming the Pacific Mail Steamship Company.

Aspiroz, as-pē'rōth, **Manuel de,** Mexican soldier, statesman, and diplomat: b. Puebla 9 June 1836; d. Washington, D. C., 24 March 1905. He graduated from the University of Mexico in 1855, was licensed to practise law in 1863, but upon the French invasion entered the army. In the Juarez insurrection of 1863 against Maximilian, he served in the insurgent army with great distinction, rising from 2d lieutenant to colonel. After the fall of Queretaro he was appointed judge-advocate of the military court which sentenced the emperor to death, thereby incurring the lasting hatred of the imperial house of Austria, of which Maximilian was a member. In 1867 Aspiroz became assistant secretary of state for foreign affairs in the new republic; in 1872 did much to settle amicably the claims between the United States and Mexico, which dated from the Mexican war in 1845; in 1873–5 was consul at San Francisco; and in 1875 was elected senator from his native province to the Mexican national congress. In 1881 he left the senate to become a member of the commission appointed to make treaties with the powers of the world; was law professor in the College of Puebla from 1883 to 1890, when he was again appointed by President Diaz assistant secretary of state, serving in that capacity until appointed, in 1899, first Mexican ambassador to the United States, a position he held till his death. In 1900 he was the Mexican representative at the Hague tribunal; was a member of several scientific organizations, a knight commander of the military Order of Our Lord Jesus Christ of Portugal, and had been presented by the Shah of Persia with the decoration of the Order of the Lion and Rising Sun, and by the dowager empress of China with the insignia of the Order of the Dragon, in both cases in appreciation of his services in negotiating treaties between their respective countries. He published: 'Código de extranjeria de los Estados Unidos Mexicanos' (1876); and 'La libertad civil como base del derecho internacional privado' (1896).

Asple'nium, a genus of about 200 species of small ferns of world-wide distribution, belonging to the sub-order *Polypodiaceæ*, characterized by free veins and elongated sori covered by an indusium. Many of the species are very beautiful and are consequently favorites with cultivators whose space is limited. *A. viride*, *A. adiantum-nigrum*, *A. trichomanes*, and other species are commonly called spleenwort from their formerly supposed efficacy in internal medicine. The two last-mentioned species also bear the name of maiden-hair, but are not the true maiden-hair fern (*Adiantum*). In the eastern United States a dozen or more species are to be found growing wild, among which the more common are *A. thelypteroides*, *A. angustifolium* and *A. felixfœmia*, which reach a height of from one to four feet. In cultivation, slight shade is almost essential, as is also abundant water at the roots, but the air must not be very moist else the leaves will turn brown. The plants thrive in peaty soil. See FERNS.

As'quith, Herbert Henry, an English statesman: b. Morley, Yorkshire, 12 Sept. 1852, and educated at Balliol College, Oxford. He studied law and was admitted to the bar of Lincoln's Inn in 1852. He entered Parliament in 1886 as member for East Fife, and was re-elected in 1892 and in 1895, and was home secretary in Gladstone's last cabinet. He was conspicuous as a debater during the Home Rule discussions, and in 1894 drew up the Welsh Church Disestablishment Bill. In December 1905 he was appointed Chancellor of the Exchequer in the Liberal cabinet of Sir Henry Campbell-Bannerman.

Ass (As. *assa*, Goth. *asilus*, Rus. *oselu*, Lat. *asinus*, probably of Eastern origin; cf. Heb. *āthōn*, she-ass) or, when domesticated, DONKEY. A member of the family *Equidæ* and usually placed in the genus *Equus*, with the horse, though sometimes made the type of a separate genus *Asinus*. There are at least three species, one Asiatic, and the others African. From the North African species the domesticated ass or donkey has probably descended, although many of its characteristics, particularly its spirit and bearing, are greatly altered. In size, in the short hair and terminal tuft of the tail, and in the fact that only the fore-legs present callosities, the ass resembles the zebra rather than the horse; and although not striped like the zebra, it has a varying tendency to stripes on the legs. The Asiatic ass (*Equus hemionus*) is divided into three local varieties, of which the one found in Persia and Syria must be that which the Old Testament writers used as a type of unhampered wildness. Of the others, the kiang, koulan, or dziggetai of Thibet, is the largest and most strikingly colored. Its height is sometimes four feet at the shoulders. Like all asses, it is pale underneath, but the color above is a dark red with a narrow black stripe along the mane and backbone from head to tail. The third variety, the onager or ghorkhar, like the first, is smaller and paler; sometimes it is even silvery, and its dorsal stripe is broader in proportion than that of the Thibetan ass. It inhabits the plains of northwestern India, Afghanistan, and Beluchistan. Unlike the donkey, these wild asses are so extremely swift, enduring, and agile that on the plains they cannot be overtaken by a single horseman. In the mountains they are less shy, and sometimes voluntarily approach travelers. Wild asses are hunted for sport, and it is said of their flesh, that, while resembling venison, it has an even finer quality. The asses of the plains migrate to the hills in summer when the plains are dry. See KIANG; ONAGER.

The African ass (*Equus Africanus*) differs widely from the Asiatic, being larger and having a bluish tint rather than a tendency to red.

It is sometimes as much as 14 hands high, and has the very large ears which characterize the donkey. The dark stripe on the back begins only at the shoulder, but extends from the tail down the withers; the hair of the mane and tail is short, and varies little from that of the body in color. It is found in all the open regions of northeastern Africa, and westward through the Sahara and Sudan. Like the Asiatic ass, it is extremely wild and fleet. A second species of African wild ass (*Equus somalicus*) was found in Somaliland a few years ago (see Proc. Zool. Soc. of London, 1884, p. 540), which is distinguished by its grayer color, and faintness of its stripes; it also has smaller ears and a more flowing mane. Living examples have been kept in London.

The leading authorities on these animals are Blanford and Tegetmeier, the latter the author of 'Horses, Asses, and Zebras' (1895).

The donkey, or domestic ass, was probably first tamed in Egypt, where it was known before the horse, and has always been much used; some of the Eastern breeds of the donkey are far larger and finer than those commonly seen in Europe, though in Spain and Italy, where they are more used, they are superior to those of other European countries. In England they are little employed, but in America are kept by stock raisers in the Middle and Southern States for the breeding of mules and hinnies. (See MULE.) Their milk is recommended in cases of consumption and dyspepsia, and their skins furnish the leather called shagreen, besides an excellent shoe-leather and the covering of drums.

Ass, Feast of the, a mock ceremony observed in northern France in the Middle Ages. It was originally a good-natured parody on the church service without intentional irreverence, but degenerated into an indecent performance. It was in substance a brief farce in which Balaam's ass appeared before the church altar to prophesy the coming of Christ.

Assab, as-säb', an Italian trading station on the coast of the Red Sea, 40 miles from the Strait of Bab-el-Mandeb. The neighboring district with an area of 243 square miles, was sold in 1870 by some Danakil chieftains to an Italian steamship company for a coaling station on the road to India. In 1880 it was taken over by the Italian government, which, since 1884, has improved the harbor and erected a lighthouse.

Assai, as-sī', a food made from the fruit pulp of various species of Brazilian palms closely allied to the cabbage palm (q.v.) and largely used in the lower Amazon region. The principal species are *Euterpe edulis* and *E. Catinga*. The first species grows in tide-flooded swamps, where it may attain a height of 90 feet with a diameter of only four or five inches. It produces upon branched spadices an abundance of small pea-like purple fruit with a thin firm pulp and a hard seed. These fruits are kneaded in warm water to produce the thick purplish assai which is generally eaten with starchy foods. The terminal bud of this species is eaten like that of its close relative, *E. oleracea*, the cabbage palm, and its stems are used as rafters and poles. The other species grow on dry, sandy, upland soils, its smaller quantity of fruit furnishing a sweeter assai.

Assal, as-säl', a large salt lake in the district of Adal, in eastern Africa, near the coast of the Bay of Tajura. It is nearly 600 feet below the level of the sea. Abyssinian caravans resort to Assal for the purpose of carrying off the salt, thickly encrusted on its shores.

Assam', a chief-commissionership of British India, situated mainly between Upper Burma and the Himalayas, with an area of 52,078 square miles. It may be considered as a long series of fertile valleys watered by the Brahmaputra and its tributaries. The valley of the Brahmaputra consists of rich alluvial plains, either but little elevated above the flood-level of the Brahmaputra and its feeders, or so low that large extents of them are flooded for three or four days once or twice in the year. The Surma valley is even more subjected to inundations than the plains of the Brahmaputra, but the Surma and its tributaries having more permanent banks, the shifting is trifling compared with the banks of the Brahmaputra. In Assam are found the valuable teak and sissoo trees, date, and sago palms, the areca palm (the betel-nut-tree), the Indian fig tree, etc. But the article of most commercial importance grown in Assam is tea. The plant was discovered growing in this region in 1823, but not till 1838 did the first shipment reach England. The plant producing it, though not regarded as specifically distinct from that of China, is much larger and more vigorous. There are now about 300,000 acres under tea; the yield is about 100,000,000 pounds annually. Rice covers a large extent of the cultivated soil, occupying about 1,500,000 acres. The other crops include maize, pulse, oil-seeds, sugar-cane, hemp, jute, potatoes, etc. In the jungles and forests roam herds of elephants, in the dense and swampy parts of the forests the rhinoceros is met with, and tigers and wild buffaloes abound; leopards, bears, and wild hogs are numerous, and among other animals are jackals and foxes, goats, deer, and the venomous cobra. Coal, petroleum, limestone, and iron are found, and gold-dust is met with in many of the rivers. The coal-beds are supposed to be co-extensive with the main valley, but coal is only worked to the south of the Brahmaputra. The inhabitants are mostly engaged in agriculture. There is no Assamese nation proper, various ethnical groups being represented. The people seem to be contented, good-natured, and indolent, and have few wants beyond what can be easily supplied from their fertile fields, for which they pay but a very small rental. Great respect is paid to the aged; parents, when no longer able to work, are supported by their offspring; they are tenderly attached to their children, kind to their relatives, and hospitable to people of their own caste. Assam, known in ancient Indian history as Kâmarûpa, formed in the 7th century A.D. a powerful independent kingdom under a Brahman sovereign, but in the 15th century it broke up into 12 separate states, which, in spite of their numerous internal struggles, were generally able to resist the attacks of the powerful Mogul emperors. Late in the 18th century its condition encouraged the Burmese to make the country a dependency of Ava, but the Burmese encroachments on the territory of the East India Company brought about war with the British. In 1826 Assam became a possession of Great

Britain under the administration of the lieutenant-governor of Bengal, and in 1874 was erected into a chief-commissionership. There are no towns properly so-called, but some large villages. The seat of administration is Shillong. Pop. (1901) 6,122,201.

Assas, äs'sä, **Nicolas, Chevalier d'**, a French officer, celebrated for an act of patriotism which cost him his life. He was captain in the regiment of Auvergne when the French army was stationed near Gueldres, in 1760, and on 15 October, while engaged in reconnoitering, was taken prisoner by a division of the enemy advancing to surprise the French camp, and threatened with death if a word escaped him. He shouted, "*A moi, Auvergne, voila les ennemis!*" and was instantly struck down. An annual pension was allowed to his descendants.

Assas'sina'tion, a term denoting the murder of any one by surprise or treachery. It is commonly applied to the murder of a public personage by one who aims solely at the death of his victim. In ancient times, assassination was often even applauded, as in the Scriptural instances of Ehud and Jael, and in the murder of Hipparchus by Harmodius and Aristogeiton; but assassination by enthusiasts and men devoted to an idea first became prominent in the religious struggles of the 16th and 17th centuries. To this class belong the plots against the life of Queen Elizabeth; while the succession of assassinations of Roman emperors is but a series of murders prompted by self-interest or revenge. Omitting these last, the following list includes the most important assassinations, arranged in chronological order. Fuller accounts of the persons mentioned will be found under their particular headings:

Philip of Macedon		B.C.	366
Julius Cæsar	Mar. 15	B.C.	44
Thomas Becket	Dec. 29,	A.D.	1170
Albert I. Emperor of Germany	May	1,	1308
James I. of Scotland	Feb.	21,	1437
Alessandro de Medici	Jan.	5,	1537
Cardinal Beaton	May	29,	1546
David Riccio	Mar.	9,	1566
Lord Darnley	Feb.	10,	1567
James, Earl of Murray, Regent	Jan.	23,	1570
William of Orange	July	10,	1584
Henry III. of France	Aug.	1-2,	1589
Henry IV. of France	May	14,	1610
Villiers, Duke of Buckingham	Aug.	23,	1628
Wallenstein	Feb.	25,	1634
Archbishop Sharp	May	3,	1679
Gustavus III. of Sweden, Mar. 16; d.	Mar.	29,	1792
Marat, by Charlotte Corday	July	13,	1793
Gen. Kleber at Cairo	June	14,	1800
Paul, Czar of Russia	Mar.	24,	1891
Spencer Perceval, premier	May	11,	1812
Kotzebue, the dramatist	Mar.	23,	1819
Duc de Berri	Feb.	13,	1820
Charles III., Duke of Parma, Mar. 26; d.	Mar.	27,	1854
President Abraham Lincoln, April 14; d.	April	15,	1865
Michael, Prince of Servia	June	10,	1868
Marshal Prim, Dec. 28; d.	Dec.	30,	1870
Georges Darboy, Archbishop of Paris	May	24,	1871
Earl of Mayo, governor-general of India	Feb.	8,	1872
Sultan Abdul-Aziz	June	4,	1876
Alexander II., Czar of Russia	Mar.	13,	1881
President James A. Garfield, July 2; d.	Sept.	19,	1881
Lord Frederick Cavendish and T. H. Burke, in Phœnix Row, Dublin	May	6,	1882
President Sadi Carnot, France	June	24,	1894
Ex-Premier Stefan Stambuloff, Bulgaria, July 15; d.	July	18,	1895
Premier Canovas del Castillo, Spain	April	22,	1897
President Juan Idiarte, Uruguay	Aug.	25,	1897
Empress Elizabeth of Austria, in Geneva	Sept.	10,	1898
President Ulisses Heureaux, Santo Domingo	July	26,	1899
King Humbert of Italy	July	29,	1900
President McKinley. Sept. 6; d.	Sept.	14,	1901
Alexander of Servia	June	11,	1903

Many attempts at assassination have been unsuccessful. Among those within the last century may be named: Against Alexander III. of Russia, repeatedly; Alfonso XII. of Spain, 1878 and 1879; Amadeus of Spain, 1872; Duc d'Aumale, 1841; Prince Bismarck, 1866 and 1874; Francis Joseph of Austria, 1853; George III. of England, 1786 and 1800; George IV. (when Regent), 1817; Humbert I. of Italy, 1878 and 1897; Isabella II. of Spain, 1847, 1852, and 1856; Louis Philippe, six attempts, from 1835 to 1846; Lord Lytton, viceroy of India, 1878; Napoleon I., by infernal machine, 1800; Napoleon III., twice in 1855, and Orsini's attempt in 1858; Queen Victoria, 10 June 1840, 30 May 1842, 3 July 1842, 19 May 1849, and 2 March 1882; William I. of Germany, 1861, 1875, and twice in 1878; President Diaz of Mexico and President Morales of Brazil, both in 1897; and the Prince of Wales in 1900.

Assas'sins, a term applied to a secret order of religious fanatics who flourished in the 11th and 12th centuries. They derived their name of assassins originally from their immoderate use of hasheesh, which produces an intense cerebral excitement, often amounting to fury. Their founder and lawgiver was Hassan-ben-Sabah, to whom the Orientals gave the name of Sheikh-el-Jobelz, but who was better known in Europe as the "Old Man of the Mountain." Their principal article of belief was that the Holy Ghost was embodied in their chief, and that his orders proceeded from the Deity. They believed assassination to be meritorious when sanctioned by his command, and courted danger and death in the execution of his orders. They were frequently styled Ismaili. A feeble residue of the sect, from whom proceeded the Druses, about A.D. 1020, has survived in Persia and Syria. The Syrian Ismaili dwell around Mesiode, and on Lebanon. They are under Turkish dominion, with a sheik of their own, and formerly enjoyed a productive and flourishing agriculture and commerce. Since the war with the Nassarians, 1809–10, they have dragged out a miserable existence, but are commended by modern travelers for their hospitality, frugality, gentleness, and piety.

Assault'. In law, an assault is a movement virtually implying a threat to strike, as when a person raises his hand or his cane in a menacing manner, or strikes at another but misses him. It is not needful to touch one to constitute an assault. When a blow actually takes effect, the crime is not simple assault, but assault and battery. Assault, however, is usually coupled with battery, and for the reason that they generally go together; but the assault is rather the initiation or offer to commit the act of which the battery is the consummation. An assault is included in every battery. An aggravated assault is one performed with the intention of committing some additional crime, such as an assault with intent to commit rape, assault with intent to murder, an assault with a deadly weapon, an indecent assault. The defenses usually interposed in cases of assault are self-defense, recapture of property, ejectment of trespassers, defense of property, defense of family, accident, etc. A person assaulting another may be prosecuted by him for the civil injury, and also be punished by the criminal law for the injury done to the public.

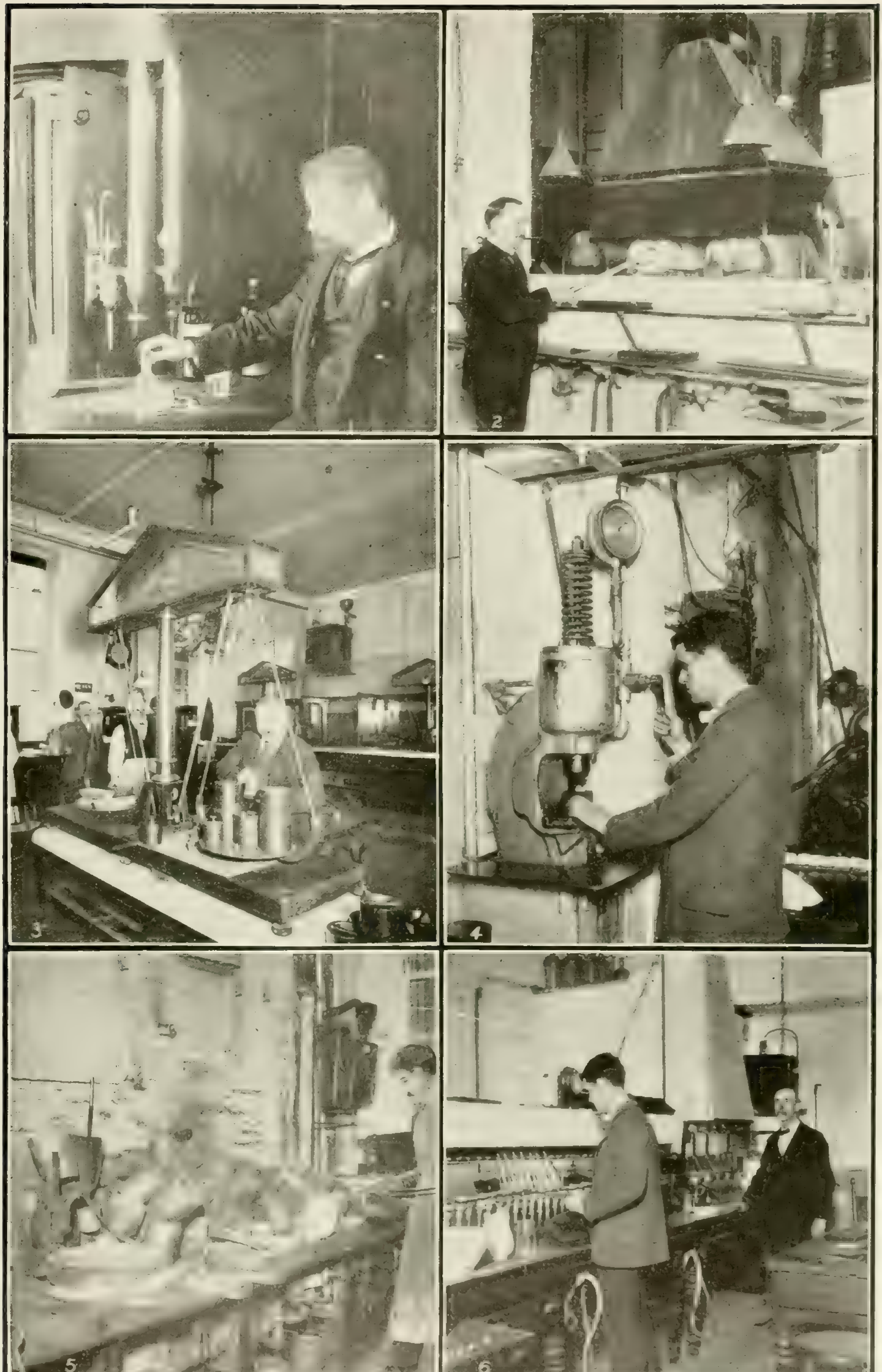
In military language an assault is a furious effort to carry a fortified post, camp, or fortress, where the assailants do not screen themselves by any works. It is the appropriate termination of a siege which has not led to the capitulation of the garrison. To give an assault: To attack any post. To repulse an assault: To cause the assailants to retreat; to beat them back. To carry by assault: To gain a post by storm. In fencing, an assault of arms is an attack on each other (not in earnest), made by two fencers to exhibit or increase their skill. (Sometimes it is used in a wider sense for other military exercises.)

Assaye, as-sī', a village in southern India, where Wellington gained a famous victory in 1803. With only 4,500 troops at his disposal he completely routed the Mahratta force of 50,000 men and 100 guns. The victory, however cost him the loss of more than a third of his men.

Assay'ing, the art of testing ores or alloys, for the purpose of determining the amount of some particular metal that is present in the material analyzed. Assays may be made by "wet" or "dry" methods, and will vary greatly in detail, according to the metal to be determined. The present article will be chiefly devoted to the usual process of estimating gold and silver in the "dry" way. The mode of procedure is substantially the same, whether the assay is made upon ore or upon bullion, except as to the method of obtaining the sample to be examined. If the material proposed for the assay is bullion, or any metallic alloy, the sample for examination is obtained by drilling into the specimen in different places, and mixing the borings. In the case of an ore, the usual method of obtaining a sample for assaying is by "quartering." If this is done by hand, every tenth shovelful of the ore to be examined is thrown upon the floor, until a conical heap containing perhaps ten tons has been accumulated. This heap is next flattened somewhat, and divided into four quarters, as nearly equal as possible. Two of the diagonally opposite quarters are thrown back into the main body of ore, and the remaining two quarters are thoroughly mixed, spread out into a second pile, and "quartered" again in the same manner. The process is continued (the ore being crushed in the meantime as often as appears necessary) until the original sample has been reduced to from one to three pounds, after which it is ground fine, and the specimens desired for examination are made up by random selections from the final pulverized product. More commonly, ores are sampled by mechanical or semi-mechanical methods, and the sampling is not done by the miner, but by a "campling mill," which acts as the agent both of the miner and of the smelting works. In such cases the ore is first shipped to the sampling mill, where it is unloaded, weighed, crushed, and passed through a chute, in which one quarter is mechanically selected and passed into a separate bin. The quarter thus mechanically reserved is next thoroughly mixed, after which the "cutting down" is commenced. This consists in removing the ore from the floor by means of a specially-constructed sampling shovel which catches about half of it, and lets the remainder fall into a barrow. The ore retained by the shovel is thrown into three buckets, in rotation, and the contents of the buckets are then coned up in one pile, and divided again in the same manner. The ore is then further crushed, and the process is continued until, finally, three samples, weighing about ten pounds each, are obtained. Part of each of these is sent separately to the assayer, who assays all three. If the results are not adjudged to be sufficiently accordant, the sampler concludes that the mixing was not well done, and the operations described are repeated. But if the three samples agree fairly well, their average is taken as representing the value of the ore; and on this basis the sampler settles with the miner, and afterward with the smelter, thus acting as a middle-man in the sale of the ore.

The specimen of ore received by the assayer is ground fine enough to pass through a 60-mesh or a 100-mesh screen, any "metallics" (or particles of metal that will not pass through the screen being carefully collected and reserved for a separate assay. If the ore is new to the assayer, his next step is to examine it microscopically, and to apply various preliminary tests, so that the general nature of the ore may be known before the quantitative work begins. If assays of the same material have been made before, and the only object is to ascertain the richness of this particular lot of ore, he may proceed directly to the process of "scorification," by which the gold and silver present in the ore are obtained in the form of a metallic button. The scorification process depends for its success upon the fact that when an ore of gold and silver is strongly heated with metallic lead in the presence of air, the baser metals that are present will oxidize, and the lead oxid that is also formed will dissolve the silica (or quartz) that is present; while the gold and silver will not oxidize, but will be left in the metallic state, alloyed with that portion of the lead which remains unoxidized. To apply this principle, 50 grains or so of the ore are mixed with some 500 grains of granulated lead, and placed in a sort of crucible, called a "scorifier." Another charge of 500 grains of lead is spread evenly over the mass, and a few grains of borax are sprinkled upon the top. The crucible and its contents are next heated for about three-quarters of an hour in a muffle to which a small amount of air is admitted, after which the melted mass in the crucible is poured into a mold to "set," or cool. When the mold is cold, it will be found to contain a button of metallic lead (in which the gold and silver originally in the ore are concentrated), and also a considerable amount of slag, consisting of oxid of lead, oxids of the base metals that are present in the ore, and silicates of lead, derived from the combination of the melted lead oxid with the quartz of the ore. The slag is readily detached from the metallic button by taps with a hammer.

The next step is to "cupel" the button, so as to obtain the gold and silver in a pure state. Cupellation is based upon the fact that when an alloy of gold, silver, lead, and base metals is heated in a current of air, the lead and the other base metals will oxidize, and the melted lead oxid ("litharge") will retain the other oxids in solution. Moreover, if the crucible in which the operation is carried out is porous, the melted lead oxid will soak into it, carrying the base oxids with it, and leaving a button of pure gold and silver behind.



[1] Humid Assay for Silver. [2] Muffle Furnaces for Fire Assay. [3] Weighing Room. [4] Pressing the Assay Sample [5] Melting Gold Bullion. [6] Extracting the Silver with Boiling Acid.

ASSAYING GOLD AND SILVER BULLION AT THE NEW YORK ASSAY OFFICE.

The "cupel" in which this is performed is made of bone-ash, and after the button left from the scorification process has been heated in the cupel for a short time, the process indicated above takes place, its completion being indicated, to the practised eye, by a play of iridescent colors on the cupelled button. The button is finally allowed to cool, and after it has been taken from the cupel, any small particles of bone-ash that remain adhering to it are removed by a brush.

If the original ore contained no silver, the assay is now completed, and it only remains to weigh the gold button, and compare its weight with that of the sample of ore used in the assay. But if silver is present, one other process, known as "parting," must be carried out, in order to separate the gold from the silver. Parting depends upon the fact that nitric acid will dissolve the silver out of an alloy of silver and gold, *provided* the weight of silver present is at least 2.5 times as great as the weight of the gold. In order to ensure the fulfillment of this necessary condition, the button, as it comes from the cupel, is melted with 2.5 or 3 times its own weight of silver that is known to be free from gold, and the alloy so formed is flattened out into a thin plate or ribbon, which is then rolled up into a little spiral, or "cornet," and boiled in nitric acid. The cornet is next washed in distilled water, and boiled again in nitric acid, to remove the last traces of silver; after which it is thrown into a crucible and melted into a button, for weighing. The button obtained by this final process consists of pure gold.

Assay Offices in the United States are government establishments in which citizens may deposit gold and silver bullion, receiving in return its value, less charges. The offices are in New York city; Boise City, Ida.; Helena, Mont.; Denver, Col.; Seattle, Wash.; San Francisco, Cal.; Charlotte, N. C.; and St. Louis, Mo.

The assay office in New York was established by law in 1853, and was opened in the autumn of 1854. The first assayer of the New York assay office was Dr. John Torrey of Columbia College, who was appointed in 1854 and held his position till 1873. On his death he was succeeded by his son, Herbert Gray Torrey, who has been in the office for 40 years. The superintendent of the assay office is Andrew Mason, who was appointed to his present position in 1883, having previously been assistant assayer and melter and refiner. While holding the latter office he substituted the use of sulphuric for nitric acid in the refining process, thus saving this one assay office $100,000 per annum.

The United States assay office is in a building located beside the more imposing subtreasury building, at the intersection of Wall and Broad streets, which marks one of the most historic spots in the country, namely, the site of the old Federal Hall, where Washington took the oath as first President of the United States. Although the building is small, yet it only masks a really large, inner building surrounded on all sides by office buildings and the sub-treasury. The assay offices, and particularly this one, have an important position in the world of finance, for here the precious metals — gold and silver — in all forms and conditions of fineness are assayed and refined. In brief, the work of this office consists in assaying or determining the value of gold and silver, in whatever form presented, as coin, jewelry, or in any other shape. Any one wishing to have gold or silver assayed in quantity or wishing to sell to the government, may present his property at the assay office, where he may have the metal reduced and made into bars, or if he prefers, he may sell his bullion to the government. The charge for doing the work is merely nominal, and based on the actual cost. Millions of dollars are stored at all times in the vaults. When the metal is received, the first step consists in weighing the coin, bars, jewelry, or tableware. This is done with great exactness and a receipt is given. Each person's holdings are placed in a box and are taken to the melting-room, where they are placed in crucibles with a flux and smelted and cast in ingot molds, the pouring being a highly picturesque operation. A small chip is taken from the bar for assay. See COINAGE.

If the depositor wishes to part with his bullion, the government pays for it at the prevailing price and proceeds to separate or part the gold from the silver. The price of gold never varies, costing $20.67 a fine ounce. Silver fluctuates with the market.

The importance of the assay office in its relation to the financial world, the treasury, and the mint cannot be overestimated. During the fiscal year ending 30 June 1900, the fineness of 11,802 melts of gold and silver deposits, 993 melts of fine gold and silver, also 1,050 melts of mixed metal, about 500 special deposits, 350 barrels of sweeps, 83,178 gold and silver bars were estimated, and about 60,000 cupels and the necessary "proof" gold and silver were made.

Assay Offices. See ASSAYING.

Assegai, ăs'se-gā, a short spear employed as a weapon among the Kaffirs of South Africa. It is made of hard wood tipped with iron, and used for throwing or thrusting.

Assemani, äs'se-mä'ne, (1) JOSEPH SIMON, a famous Orientalist: b. of a Maronite family in Tripoli, Syria, 1687; d. Rome, 14 Jan. 1768. He traveled on the Pope's commission through Egypt and Syria, collecting many Oriental manuscripts and coins for the Vatican library, of which he was appointed keeper. Of his numerous learned works, the most important is 'Bibliotheca Orientalis,' issued by order of Clement XI. and containing (in manuscript form) the Vatican codices in Syriac, Arabic, Persian, Turkish, Hebrew, Samaritan, Armenian, Ethiopian, Greek, Egyptian, Iberian, and Malabaric. (2) STEPHEN EPHODIUS (1707–82), also a learned author of books on Oriental learning. He was titular archbishop of Apomaca, Syria. Yet another nephew and Orientalist was (3) JOSEPH ALOYSIUS (1710–82), professor at Rome. (4) SIMON, a relative of the preceding, b. in Tripoli 1752; d. Padua 8 April 1821. He filled the chair of Oriental languages at Padua. He wrote an important work on ancient coins, 'Museo Cufico Naniano Illustrato' (1787–8).

Assemblages, General Theory of. The doctrine variously entitled *Mengenlehre* and *Mannigfaltigkeitslehre* by the Germans, *Théorie des ensembles* by the French, and sometimes referred to in English as the theory or doctrine of

manifolds or aggregates or by other analogous designations. Many of its ideas are at least as ancient as historical thought and have figured in important ways in logic, philosophy and mathematics steadily from the earliest times. On the other hand, many of the chief concepts involved in it, its characteristic notions, and their organization into a distinct and self-supporting body of coherent doctrine, may be said to constitute the latest great mathematical creation. Indeed the majority of the founders and builders of the doctrine, including Georg Cantor as easily the primate of them all, are still among the living. As mathematics is the most fundamental of the sciences, the theory of assemblages seems destined to be regarded, if it be not already regarded, as the most fundamental branch of mathematics. Viewed in retrospect, it appears as an inevitable product of the modern critical spirit. Already it is seen to underlie and interpenetrate both geometry and analysis. Its connection with mathematical logic is most intimate, often approximating identity with the latter; and even philosophy is surely, if but slowly, beginning to recognize in the theory of manifolds her own most inviting and promising field.

The Notions, Assemblage and Element.—Roughly speaking, any collection of objects or things of whatever kind or kinds is an assemblage. Each object in the collection is called an element of the assemblage. An assemblage, to be mathematically available, must be defined, or, as usage has it, well-defined (*wohldefinirt, bien defini*). An assemblage is defined when, by the logical principle of excluded middle, it can be regarded as intrinsically determined whether an arbitrarily given object is or is not an element of it. Means may or may not be known for making the determination actual or extrinsic. Thus if the elements of the assemblage be completely tabulated, the determination can be actually effected by comparing the given object with the elements of the table. Again, if an assemblage, such as that of the endless sequence 1, 2, 3, . . . of integers, be given by a definite law of formation of its elements, the law will generally enable one to determine actually whether any given object, as 5 or $\frac{1}{2}$ or an apple or a sunset, is an element of the assemblage or not. But the possession of such means is not essential to the notion of defined assemblage. A real * number is called *algebraic* or *transcendental* according as it is or is not a root of an equation of the form, $a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x + a_n = 0$, having integral coefficients. Any real number, no matter what its origin or definition, is either algebraic or transcendental; it cannot be both and it cannot be neither. Hence the real algebraic numbers constitute a defined assemblage, and so, too, the transcendentals. Nevertheless no means is known for ascertaining in every case whether a given number is algebraic or not. It was really a great achievement when the transcendental character of the long familiar classical numbers e and π was proved, for e by Hermite in 1874 and for π nine years later by Lindemann. Even the existence of non-algebraic numbers was unknown till it was proved by Liouville in 1851.

* The exigencies of the present undertaking demand the expository use of data drawn from the Theory of the Real Variable (which see) and other theories, although these are themselves branches of assemblage theory.

Depiction and Correspondence.—Assemblages will be denoted by large and elements by small letters. If, in any way, each element a of A is associated with an element b of B, A is said to be *depicted* on B. The b's so used are the *pictures* of the a's. If all the b's are thus made pictures, B is also depicted on A and the a's are pictures of the b's. If an a is a picture of a b and reciprocally, and if this relation holds for all the a's and b's, so that there is a one-to-one correspondence between them, the depiction is called *similar*. Obviously an assemblage can be depicted either similarly or dissimilarly on itself, generally in more than one way, often in an endless variety of ways.

The Concept Chain.—If the elements of A are elements of B, A is part of B. If in this case not all b's are a's, A is *proper* part of B. Any assemblage is part, but not proper part, of itself. One of the most important ideas connected with that of the depiction of an assemblage on itself is the notion of *chain*: if A be depicted on itself in any definite way, then any part of A that is thereby depicted on itself is a chain. In case of a given depiction of an A on itself, the most important of the chains so arising is that one that is composed of the elements, each taken but once, of all the chains having in common a previously chosen part of A. There is always one such special chain for a given part and given mode of depiction, but it changes with the part and with the mode independently. The theory of chains, due to Dedekind, has fundamental bearings in logic (see INDUCTION, MATHEMATICAL).

The Concept of Equivalence and Sameness of Power.—If A and B are such that each may be similarly depicted on the other, *i.e.*, if a one-to-one correspondence can be established between the elements of A and those of B, A and B are said to be *equivalent* or to have the *same power* (*Mächtigkeit*), a relation symbolically expressed by writing $A \backsim B$ or $B \backsim A$. Thus if A denote the assemblage of positive integers and B denote, say, the even positive integers, $A \backsim B$, for plainly one may pair 1 with 2, 2 with 4, 3 with 6, and so on. Other ways of pairing A and B in this case will readily occur to the reader.

Distinction of Finite and Infinite.—An assemblage is *finite* or *infinite* according as it has not or has the same power as some proper part of itself. Thus A of the last example is infinite. So, too, is B, for it is easily seen that if $A \backsim B$ and if either A or B is infinite, so is the other. Also, if $A \backsim B$ and if A or B is finite, so is the other. The foregoing definition of infinite is one of the most fruitful of modern concepts. It is due independently to Dedekind and Georg Cantor. Sometimes an infinite assemblage is defined to be one that cannot be exhausted or emptied by removing from it one element at a time. It has been proved that the two definitions are logically equivalent. But for the purposes of investigation, the former is found to be by far the better instrument. An infinite assemblage is often described as *transfinite*.

Denumerability.—Let A denote the assemblage of positive integers. Any assemblage B such that $B \backsim A$ is said to be *denumerable* or to have the power of the denumerable assemblage. As $A \backsim A$, A is itself denumerable, and it serves conveniently as the *type* of denumerable assem-

blages. The domain of such assemblages is exceedingly rich and is replete with surprises. For example, though the rational fractions, that is, fractions having integral terms, are so numerous that between any two of them, however near to each other in value, there is an infinity of others, nevertheless the assemblage of rational fractions including the integers is denumerable. Of this the reader can quickly convince himself by reflecting that there is but a finite number of such fractions of which each has a specified integer n for sum of its terms. Thus, if $n=2$, one has 1 or $\frac{1}{1}$; if $n=3$, one has $\frac{1}{2}$ and $\frac{2}{1}$; if $n=4$, $\frac{1}{3}$, $\frac{2}{2}$, $\frac{3}{1}$; and so on. Some are repeated; repetitions may be kept or rejected. Keeping them, the required equivalence is seen in the pairing: (1, 1); (2, $\frac{1}{2}$), (3, $\frac{2}{1}$); (4, $\frac{1}{3}$), (5, $\frac{2}{2}$), (6, $\frac{3}{1}$); . . . . In ordinary speech one is justified in saying that rational numbers are neither more nor less numerous than the integers or than the odd or the even integers. It is plain that the classic axiom, the whole is greater than any of its parts, is not valid for infinite assemblages. For finite assemblages it is valid absolutely, but for none other. For another example, consider the algebraic numbers, before mentioned. These include the rationals and infinitely many besides. Nevertheless the assemblage of all algebraic numbers is denumerable. The proof is too long to insert here. Yet more astonishing is the theorem that an assemblage composed of all the elements of a denumerable infinity of denumerably infinite assemblages is denumerable.

The Power of the Continuum.—At this stage the query is natural: is every possible assemblage denumerable? The answer is negative. The assemblage of all real numbers, *i.e.*, of all rationals and irrationals, is said to constitute a *continuum*. So, too, the assemblage of points of a straight line is a continuum, in particular a *linear* continuum. The last two assemblages are in fact of the same power, but neither is denumerable. This is demonstrated by letting $a_1, a_2, \ldots, a_n, \ldots$ represent *any* denumerable assemblage of real numbers and then proving that between any two arbitrarily assumed numbers α and β there is one number and therefore an infinity of numbers not in the given sequence. From this proposition of Cantor's the existence of transcendental numbers, which had been otherwise previously proved by Liouville, follows as a corollary. Any assemblage equivalent to that of the real numbers or to that of the points of a straight line is said to have the power of the continuum. The assemblage of points of any line-segment however short or, what is tantamount, the assemblage of numbers between any two numbers however nearly equal, has the power of the continuum. Indeed, either of these assemblages is a continuum. But an assemblage may have the power of the continuum without being a continuum. For example, the assemblage of transcendental numbers, though it is not a continuum, has the power of a continuum. In fact, the assemblage left on suppressing from a continuum any denumerable assemblage of elements is equivalent to the original assemblage. This last is a special case of the proposition: if A be infinite, and if the remainder R on suppressing a denumerable part of A be infinite, then $R \backsim A$. As above seen the power of the continuum is higher than that of the denumerable assemblage, but whether it is the *next* higher is an outstanding question. There are higher powers than that of any given power (unless this last be that of the assemblage of *all* things, a concept whose admissibility is questioned), but no assemblage of points has a power higher than that of a continuum. On the contrary, it is one of the most marvelous of known facts that the assemblage of points on a line-segment however short is equivalent to the assemblage of all the points of space, nay, is equivalent to all the points of a space having not merely, like our own, three dimensions, but a denumerable infinity of dimensions.

Limit-points, Dense and Derived Assemblages.—The *neighborhood* or vicinity of a point p is a region *small at will* taken about p. If p be in space, the neighborhood may be a sphere having p as center; if p be in a plane or in a line, the neighborhood will naturally be a circle or a line-segment. The following discussion, conducted for assemblages of points of a straight line, is readily extensible to other point assemblages. Denote by P any given assemblage of points of a line. If there be a point p, in P or not, such that in the neighborhood of p there is one point (and hence an infinity of points) of P, then p is a *limit-point* of P. If p be in P but not a limit-point, p is an *isolated* point of P. The assemblage of all the limit-points of P is the *first derived* assemblage $P^{(1)}$ of P. The first derived of $P^{(1)}$ is the *second* derived of P, namely, $P^{(2)}$; and so on. If P be finite, its $P^{(1)}$ contains no points, it is *empty*. If P be infinite and in a segment, $P^{(1)}$ contains at least one point—a proposition of exceeding importance in function theory. If the nth derivative $P^{(n)}$ be empty and the preceding derivative contains one or more points, P is said to be of *first genus* and nth *species*. If $P^{(n)}$ contain points for every positive integral value of n, P is said to be of *second* genus. Every point of a given derivative of P is a point of each preceding derivative, but P may contain points not in any of its derivatives. If some or all of the points of P are in an interval $(\alpha \ldots \beta)$ and if every sub-interval of the given one contains a point or points of P, P is said to be *dense throughout* the given interval. For example, the assemblage of points whose distances from a fixed point of the line are rational numbers is dense throughout every interval. If P be dense throughout a given interval, so is every derivative; in fact, each derivative in such case contains all points of the interval, and conversely. Hence one might *define*: P is dense throughout an interval when and only when $P^{(1)}$ contains every point of the interval. Obviously, if P is dense throughout an interval, P is of second genus, and so, too, are its derivatives. It follows that if P or one of its derivatives be of first genus, P is not dense in any interval. But it is not true that every P of second genus is dense throughout some interval.

Greatest Common Divisor, Least Common Multiple.—The equation $P \equiv Q$ will signify that the point assemblages P and Q are identical. Two assemblages having no element in common are said to be *without connection*. If P contains all and only the points of the assemblages P_1, P_2, . . . , every two of the latter being without connection, the fact is expressed by writing $P \equiv (P_1, P_2, \ldots)$. A part of P is called a *divisor* of it, and P is a *multiple* of each of its divisors.

The symbol, $D(P_1, P_2, \ldots)$, is read *greatest common divisor* of $P_1, P_2, \ldots$ and is the assemblage of their common points. $M(P_1, P_2, \ldots)$ is read *least common multiple* of $P_1, P_2, \ldots$ and is the assemblage of all the different points of the P's, it being understood that the latter have no common point. To express that P is empty, one may write $P \equiv 0$. If and only if P and Q are without connection, $D(P, Q) \equiv 0$. Each derivative of P is a divisor of every preceding derivative. If P is of second genus, then $P^{(1)} \equiv (Q, R)$, where Q is the assemblage of those points of $P^{(1)}$ that are not common to $P^{(1)}$, $P^{(2)}, \ldots$, and R is the assemblage of those that are common.

Transfinite Derivatives.—R is therefore defined by the equation $R \equiv D(P^{(1)}, P^{(2)}, \ldots)$ or by $R \equiv D(P^{(2)}, P^{(3)}, \ldots)$, or by $R \equiv D(P^{(n_1)}, P^{(n_2)}, \ldots)$, where $n_1, n_2, \ldots$ are a denumerably infinite assemblage of increasing positive integers. R is obviously a derivative of P, but the *order* of the derivative is not expressible by a number of the sequence 1, 2, 3, . . . ; these numbers are finite, the order of the derivative is transfinite, is denoted by ω, and one may write $R \equiv P^{(\omega)}$. The first derivative of $P^{(\omega)}$ is denoted by $P^{(\omega+1)}$, and the nth by $P^{(\omega+n)}$. If $P^{(\omega)}$ have a derivative of transfinite order ω, it is denoted by $P^{(2\omega)}$. Continuation of the process yields $P^{(\omega^2)}$, $P^{(\omega^\omega)} \equiv D(P^{(\omega)}, P^{(\omega^2)}, P^{(\omega^3)}, \ldots)$, $P^{\left(\omega^{\omega^\omega}\right)}$, and so on endlessly. For any assemblage P of first genus, $P^{(\omega)} \equiv 0$, an equation serving to characterize assemblages of first genus. Assemblages of second genus are definable for which the derivative of any given transfinite order shall consist of a single specified point.

If $D(P, P^{(1)}) \equiv 0$, P is an assemblage of *isolated* points. From any assemblage P, an assemblage Q of isolated points is obtainable by suppressing from P the assemblage $D(P, P^{(1)})$, and one may write $Q \equiv P - D(P, P^{(1)})$. It is known that if P be an assemblage of isolated points, it is denumerable, though, as above noted, the converse is not true. Also, if $P^{(1)}$ is denumerable, so is P; but not conversely, for, for example, the assemblage of rational fractions is denumerable, while its first derivative is a continuum, namely, the assemblage of real numbers. Again, if P be of second genus, and if $P^{(\alpha)}$, α being finite or transfinite, be denumerable, so, too, is P denumerable. A very remarkable theorem is the following: if P be in any given interval and if $P^{(1)}$ be denumerable, the points of P can be enclosed in a *finite* number of sub-intervals having a sum less than *any* prescribed length.

Perfect Assemblages.—If P and $P^{(1)}$ coincide, P is called a *perfect* assemblage; in the contrary case, imperfect. For example, if P is the assemblage of points of the interval from p_1 to p_2, including p_1 and p_2, P is perfect; but if P includes only the points *between* p_1 and p_2, P is imperfect, for clearly $P^{(1)}$ includes p_1 and p_2. The definition just given is Cantor's. Another current definition is that by Jordan: P is perfect if it *includes* $P^{(1)}$. It has been proposed to distinguish the two by describing an assemblage, if perfect in Cantor's sense, as *absolutely perfect*, and, if perfect in Jordan's but not in Cantor's sense, as *relatively perfect*. It has been proved that if P be relatively perfect, the assemblage R which results on suppressing $P^{(1)}$ from P is denumerable. But it is not true that every absolutely perfect assemblage is decomposable into a relatively perfect assemblage and a denumerable assemblage. The theory of perfect assemblages, though exceedingly subtle, is far simpler than that of imperfect assemblages. Every derivative of P is relatively perfect. There are absolutely perfect assemblages not dense in any interval.

Measure and Measurable Assemblages.—An assemblage P of all the points in a denumerable infinity of intervals that do not overlap and whose total length is s is said to have the *measure* s. If P and P' be without connection and have measures s and s', the measure of $M(P, P')$ is $s+s'$. If s and s' be the measures of P and P', and if P' be a divisor of P, the measure of $P-P'$ is $s-s'$. The measure of an assemblage is always *zero* or *positive*. The measure of any denumerable assemblage is zero, but zero may be the measure of a non-denumerable assemblage, and an assemblage is non-denumerable if its measure be not zero. An assemblage is said to be *measurable* only in case the foregoing definitions associate with it the notion of measure. A *restricted* or limited assemblage is one such that the distance between every pair of its points is less than a prescribed number. It has been proved that every restricted assemblage that is perfect relatively or absolutely is measurable. The doctrine of the measurability and content of assemblages is of great importance, but it cannot be further entered into here.

Improper Infinite and Proper Infinite, or Transfinite.—The *ordinary* notion of mathematical infinity is that of a finite variable, such as $\tan \alpha$, which can take a finite value greater than any previously specified finite value; and such an equation as $\tan 90° = \infty$ is understood by mathematicians to be a kind of short-hand for saying that, by taking α near enough to 90°, $\tan \alpha$ can be made to exceed any preassigned finite number, and it does not mean that ∞ is a value that $\tan \alpha$ may assume. Similar illustrations abound. Such a variable as thus remains always finite but may be made *large* at will is sometimes described as an *Infinite* (variable) in analogy with the reciprocal notion of *Infinitesimal*, a variable that remains always finite but may be made *small* at will. Such infinites are described by Cantor as *improper* infinites. On the other hand both geometry and analysis have long recognized another sort of infinite, *viz.*, one that is not variable but is *constant*. Such an infinite, for example, is the distance from any finite point of a range (see PROJECTIVE GEOMETRY) to the point common to the range and any parallel range. Another example is the distance from any finite point of the complex plane and the «infinite point» of the plane (see COMPLEX VARIABLE). Such infinites are styled by Cantor *proper infinites*, or transfinites. The examples just given of transfinites are transfinites *just* beyond the border of the finite. Cantor has generalized the generalization, and by one of the boldest procedures in the annals of mathetic genius he has created higher and higher classes of transfinite assemblages and numbers and subjected them to a logically consistent system of laws of operation. Of that procedure and of its results a brief account will now be given.

Principles of Number Generation, or of Definition of Classes.—These principles are three in

number: (1) *adding unity, or 1, to a number already formed;* (2) *in case of any given endless succession of integers having among them no greatest, positing a new integer that shall be the first greater than each integer of the succession;* (3) *the imposition on numbers generable by* (1) *and* (2) *of the condition that the succession of numbers preceding any given number so generated shall have the power of a class of numbers already defined.* The last is known as the principle of *arrest* or *limitation.* Cantor names the principles «the three logical moments», an ideally improper designation, for the applications of the principles are precisely the points in his procedure where it transcends logic and rises to the level of the creative or generalizing will. Generalization is neither logical nor illogical, it is always superlogical, an act of will directed by immediate perception.

The first class (I) of integers is the denumerably infinite assemblage of *finite* integers $1, 2, 3, \ldots \nu, \ldots$; generated or generable by (1). (I) contains no greatest and no last. By (2) the number ω is given to be the first integer greater than every number of (I). Combination of (1) and (2) yields $\omega+1$, $\omega+2, \ldots$, 2ω, $2\omega+1, \ldots$, $\nu_0\omega_\mu+\nu_1\omega_{\mu-1}+\ldots+\nu_{\mu-1}\omega+\nu_\mu$, $\ldots$, $\omega^\omega, \ldots$, $\omega^{\omega^\omega}, \ldots$, $\alpha, \ldots$, in endless succession. Herewith, however, is not *defined* a class of numbers that can be transcended by (1) and (2). The second class (II) of integers is defined by aid of (3) thus: it consists of those numbers that are generable by (1) and (2), that are orderable as in the preceding sequence, and that are such that all those which come before any specified one of them, say α, shall have the power of class (I). It has been proved that (II) has a power different from, indeed next higher than, that of (I). Combination of the three principles suffices to define distinct classes of higher and higher power, there being no restriction on the sublime crescendo except such as may inhere in the constitution of mind.

Transfinite Cardinal Numbers and their Laws.—The reader will naturally ask: Are the transfinite integers subject to law? They are, a fact best seen on approaching the matter from another but closely related point of view, as follows: Denote by A any assemblage of elements a; symbolically, $A=\{a\}$. On disregarding *both* the *character* of the a's and any and every *order* of their arrangement, a new assemblage, an *orderless* assemblage of *characterless* elements (*units*), arises, called the *power* or *cardinal number* of A and denoted by the symbol $\overline{\overline{A}}$. Herewith the term *power* (*Mächtigkeit*) is itself defined; *sameness of power* was defined above. Plainly every assemblage has a definite power, or cardinal number. Note that the cardinal number of an assemblage is by definition a definite assemblage: that which results on abstracting (the attention) from the *order* and *kind* of its elements. The equation $\overline{\overline{A}}=\overline{\overline{B}}$ means that A and B have the same or equal powers or cardinal numbers. It is easily seen that, when and only when $A \backsim B$, $\overline{\overline{A}}=\overline{\overline{B}}$. If $A, B, C, \ldots$ have no common element, the assemblage of all the elements involved will be denoted by $(A, B, C, \ldots)$. If also $A', B', C', \ldots$ have no common element, and if $A\backsim A'$, $B\backsim B'$, $C\backsim C', \ldots$, then $(A, B, C, \ldots)\backsim(A', B', C', \ldots)$, and the cardinal numbers of these composite assemblages are equal, or the same.

Notion of Greater and Less Powers or Cardinals.—If A and B are such that A has no part equivalent to B and that B has a part equivalent to A, the cardinal number of A is said to be *less* than that of B, that of B *greater* than that of A; symbolically, $\overline{\overline{A}}<\overline{\overline{B}}$, or $\overline{\overline{B}}>\overline{\overline{A}}$. If α, β, γ are cardinal numbers, and if $\alpha<\beta$, and $\beta<\gamma$, then $\alpha<\gamma$. Any one of the relations $\alpha=\beta$, $\alpha<\beta$, $\alpha>\beta$, excludes the other two. But it does not *follow* that every pair of cardinals α and β must satisfy one of the three relations, though they in fact do. This last proposition belongs to the theory of *well-ordered* assemblages, a term explained at a later stage of this writing.

Addition of Powers or Cardinals.—If α and β be the cardinal numbers of A and B, A and B having no common element, and if γ be the power of (A, B); then $\alpha+\beta=\gamma$. Such is the definition of addition. As a power is an orderless assemblage, $\alpha+\beta=\beta+\alpha$, and, in case of any three powers, $\alpha+(\beta+\gamma)=(\alpha+\beta)+\gamma$; that is, addition of powers is *commutative* and *associative.*

Multiplication.—Let $A=\{a\}$ and $B=\{b\}$. Associate each a with each b. Consider each pair (a, b) as an element. The assemblage of these is denoted by $(A\cdot B)$. Hence $(A\cdot B)=\{(a, b)\}$. The power γ of this last obviously depends only on the powers α and β of A and B. Hence the definition of *product*: $\alpha\cdot\beta=\gamma$. As the power, or cardinal number, of an assemblage is orderless, it is readily seen that $\alpha\cdot\beta=\beta\cdot\alpha$, and that, for any three powers, $\alpha\cdot(\beta\cdot\gamma)=(\alpha\cdot\beta)\cdot\gamma$, $\alpha\cdot(\beta+\gamma)=\alpha\cdot\beta+\alpha\cdot\gamma$; that is, multiplication of powers is *commutative*, *associative*, and *distributive.*

Involution.—If with each a of A a b of B be associated, any a and the associate b will be a *pair.* The same b may enter two or more pairs. The assemblage of all the pairs resulting from any such definite association is called a *covering* of A with B, and is denoted by $f(A)$. A different covering results if with any a there be associated a b not associated with it before. The assemblage of all possible coverings of A with B is denoted by $(B|A)$; then $(B|A)=\{f(A)\}$. The power γ of $(B|A)$ depends only on the powers α and β of A and B; hence the *definition*: $\alpha^\beta=\gamma$. It is readily seen that, if α, β, γ denote any three powers, $\alpha^\beta\cdot\alpha^\gamma=\alpha^{\beta+\gamma}$, $\alpha^\gamma\cdot\beta^\gamma=(\alpha\cdot\beta)^\gamma$, and $(\alpha^\beta)^\gamma=\alpha^{\beta\cdot\gamma}$.

It is an interesting fact that by means of the foregoing definitions of power, and addition, multiplication, and involution of powers, the definition and the fundamental properties of the ordinary (finite) cardinals $1, 2, 3, \ldots, \nu \ldots$ can be rigorously deduced.

The Smallest Transfinite Cardinal.—The cardinal number of the assemblage $\{\nu\}$ of finite cardinals is denoted by $\aleph_0$, alef-null. Symbolically, $\aleph_0=\overline{\overline{\{\nu\}}}$. The transfinite number $\aleph_0$ has the properties: $\aleph_0+1=\aleph_0$; $\aleph_0>\mu$, where μ is any finite cardinal; $\aleph_0<\alpha$, where α is any transfinite cardinal different from $\aleph_0$; $\aleph_0+\aleph_0=\aleph_0$; $\nu\cdot\aleph_0=\aleph_0\cdot\nu=\aleph_0$, where ν is any finite cardinal; $\aleph_0\cdot\aleph_0=\aleph_0$; $\aleph_0{}^\nu=\aleph_0$; etc. It is one of the wondrous facts met with in the doctrine of transfinite assemblages that the cardinal number of the points of space or other continuum is precisely $2^{\aleph_0}$.

Simply Ordered Assemblages, Order-types.—A is *simply ordered* when and only when its ele-

ments a are so disposed that of every pair a_1, a_2 of them, one, as a_1, precedes, *i.e.*, has *lower rank* and the other, as a_2, comes *after*, *i.e.*, has *higher rank*, and of every triplet a_1, a_2, a_3, a_1 is lower than a_3, if a_1 is lower than a_2 and a_2 is lower than a_3. To say symbolically that a_1 is lower in rank than a_2 and that a_2 is higher than a_1, we write either $a_1 \} a_2$ or $a_2 \} a_1$. A simply ordered assemblage that is further so arranged that it has an element of *lowest* rank, a *first* element, and that every part of it has a first element, is said to be *well-ordered.* For example, the assemblage of rational fraction greater than zero and less than one, if arranged in natural order, so that the larger the fraction the higher its rank, is simply ordered but not well-ordered. The same assemblage can, however, be well-ordered, thus: $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{2}{3}, \frac{1}{5}, \frac{1}{6}, \frac{2}{5}, \frac{3}{4}, \ldots$, where the scheme is that $\frac{p_1}{q_1}$ shall have lower rank than $\frac{p_2}{q_2}$ when p_1+q_1 is less than p_2+q_2, and if $p_1+q_1=p_2+q_2$, then the fraction having the smaller number for sum of its terms shall have the lower rank. It has been very recently proved that every assemblage can be well-ordered. Immediate important consequences are: (1) every transfinite assemblage can be so ordered that after each element there shall be a *next*; (2) every assemblage can be so arranged that every sequence $a_1, a_2, a_3, \ldots$ of its elements, for which $a_1 \} a_2$, $a_2 \} a_3, \ldots$, shall have an end; (3) every pair of assemblages are comparable in respect to their cardinal numbers.

If A be a simply ordered assemblage, the new assemblage obtained by abstracting from the character of the elements of A is called the *order-type* of A and is denoted by $\overline{A}$. Obviously, $\overline{A}$ is simply ordered. If A and B are simply ordered, and if their elements can be paired in one-to-one fashion so that the *rank* relation of every two elements a_1 and a_2 of A shall be the same as the rank relation of their correspondents b_1 and b_2 in B, then A and B are said to be *similar*, and to be *depictable* on one another. This definition of similar and depictable, it is noteworthy, are more restricted than that above given. The similarity of two similar simply ordered assemblages A and B is expressed by writing $A \simeq B$. If A is simply ordered, $A \simeq A$, and if B and C are simply ordered, and if $A \simeq C$ and $B \simeq C$, then $A \simeq B$. It is plain, too, that either of the relations, $\overline{A}=\overline{B}$, $A \simeq B$, implies the other.

To every order-type, or ordinal number, corresponds a power, or cardinal number. Thus to $\overline{A}$ corresponds $\overline{\overline{A}}$. The distinction of ordinal and cardinal is of no importance for finite assemblages, but is absolutely indispensable in the doctrine of transfinites. All order-types corresponding to a finite cardinal α are similar, but those corresponding to a transfinite cardinal present a countless variety and are said to constitute a *type-class* $[\alpha]$. To every transfinite cardinal corresponds such a type-class. Any type-class is itself an assemblage, namely, of order-types, and as such has its own cardinal number, which may be shown to be greater than that of each of the order-types involved.

Addition and Multiplication of Order-types.—If A and B are simply ordered, it will be understood that in their union (A, B) the elements of A have the same rank relation as in A, that the like is true of B, and that every a is of lower rank than every b. Hence (A, B) is simply ordered. If A' and B' are simply ordered and if $A \simeq A'$ and $B \simeq B'$, then $(A, B) \simeq (A', B')$. Hence the order-type of (A, B) depends only on $\alpha=\overline{A}$ and $\beta=\overline{B}$. Hence the definition of addition: $\alpha+\beta=\overline{(A, B)}$. Here α is the *augend* and β the *addend*. If α, β, γ be any three types, $\alpha+(\beta+\gamma)=(\alpha+\beta)+\gamma$; *i.e.*, addition of ordinals is associative; but, unlike cardinals, ordinals do not in general obey the *commutative* law. For example, if $\omega=\overline{E}$, where E denotes $e_1, e_2, \ldots, e_\nu, \ldots, e_\nu \} e_{\nu+1}$, and if f be any new element, then $1+\omega$ does not equal $\omega+1$, for (f, E) and (E, f) are not similar, the latter having a *last* element, while the former has not.

Next from the simply ordered assemblages A and B, form the assemblage S by replacing each b by an assemblage $A_b \simeq A$. It is easily seen that the order-type of S depends only on $\alpha=\overline{A}$ and $\beta=\overline{B}$. Hence the definition of multiplication: $\alpha \cdot \beta=\overline{S}$. Here α is multiplicand and β is multiplier. It is readily proved, in respect to three types α, β, γ, that $(\alpha \cdot \beta) \cdot \gamma=\alpha \cdot (\beta \cdot \gamma)$ and that $\alpha \cdot (\beta+\gamma)=\alpha \cdot \beta+\alpha \cdot \gamma$. That is, multiplication of ordinals like that of cardinals is *associative* and *distributive*. But in general ordinals do *not* obey, while cardinals always obey, the *commutative* law. The reader can easily convince himself that, for example, $\omega \cdot 2 \neq 2 \cdot \omega$.

Order-type of Rationals.—Denote by R the rational numbers greater than 1 and less than zero, taken in *natural* order. Let $\eta=\overline{R}$. Obviously η belongs to the type-class $[\aleph_0]$, for we have seen that R is denumerable. Moreover, R is *dense* and has no element of *lowest* rank and none of *highest*. By these three properties, R is completely characterized; that means that if A is simply ordered, dense, denumerable, and has neither lowest nor highest element, A and R are similar, and $\eta=\overline{A}$. It follows that $\eta+\eta=\eta$, $\eta \cdot \eta=\eta$, $(1+\eta)\eta=\eta$, $(\eta+1)\eta=\eta$, $(1+\eta+1)\eta=\eta$, but $\eta+1 \neq 1+\eta$, and, though $\eta+1+\eta=\eta$, $\eta+\nu+\eta \neq \eta$, if $\nu>1$.

Order-type of Linear Continuum.—Denote by θ the order-type of the linear continuum $X=\{x\}$, where $0 \leqq x \leqq 1$, and where X is disposed in natural order, *i.e.*, so that if x and x' be any two elements of X, $x \} x'$, when and only when $x<x'$. Now X is dense and perfect. It also contains R in such way that in respect to rank there are elements of R between every pair of x's. So is suggested the following fundamental theorem, which serves to characterize the type of the linear continuum completely: *If a simply ordered assemblage A is perfect and if it contains a denumerable assemblage P such that in respect to rank P has elements between every two elements of A, then $\theta=\overline{A}$.*

For detailed elaboration of the foregoing notions and for extensions of the doctrine, the reader is referred to the

Bibliography. — Bolzano, 'Paradoxien des Unendlichen' (1850); du Bois-Reymond, 'Die Allgemeine Funktionlehre' (1882); G. Cantor, 'Grundlagen einer allgemeine Mannigfaltigkeitslehre' (1883), and many other contribu-

tions by Cantor in 'Mathematische Annalen' and in vol. II. of 'Acta Mathematica'; Bettazzi, 'Teoria delle grandezze' (1891); Veronese, 'Fondamenti di geometria' (1891, also in German); Borel, 'Leçons sur la théorie des fonctions' (1898); Vivanti gives résumé of chief ideas and results in 'Bibliotheca mathematica, neue Folge 6' (1892); Schönflies gives a more comprehensive digest, vol I. of 'Encyklopädie der Mathematischen Wissenschaften' (1899); Zermelo has an important contribution in vol. 59, 'Mathematische Annalen' (1904).

Cassius J. Keyser,
Adrian Professor of Mathematics, Columbia University.

Assem'bly, Constituent. See Assembly, National.

Assem'bly of Divines, a celebrated assembly appointed by the Long Parliament, and held at Westminster to determine upon the doctrine and liturgy of the English Church. By an ordinance passed 12 June 1643, 121 clergymen, with 10 Lords and 20 Commoners as lay assessors, were nominated as constituents of the assembly. The assembly began its sittings in July 1643, in Westminster Abbey, but in the meantime a royal proclamation had been issued forbidding the assembly to meet, which had the effect of inducing the greater part of the Episcopal members to absent themselves. The majority of those who remained were Presbyterians, but there was a strong minority of independents. A deputation was now sent along with commissioners from the English Parliament to the General Assembly of the Scottish Church and the Scottish Convention of Estates, soliciting their co-operation in the proceedings of the Westminster Assembly, and in September four Scottish clergymen, with two laymen, were admitted to seats and votes. The assembly continued to hold its sittings till February 1649. Among the results of its deliberations were the Directory of Public Worship, the Confession of Faith, and the Larger and Shorter Catechisms, which remain practically the standards of the Presbyterians to the present day. At the Restoration the whole proceedings of the Westminster Assembly were annulled as invalid. See Hethorington, 'History of the Westminster Assembly' (1843); Masson, 'Life of Milton' (1858–79).

Assem'bly, General, the name applied to the highest ecclesiastical court of the Established Church of Scotland. It consists of delegates from every presbytery, university, and royal burgh in Scotland, holds meetings annually, in the month of May, and usually continues to sit for 12 days. In its judicial capacity and as the court of last resort, the General Assembly has a right to determine finally every question brought from the inferior courts, by reference, complaint, or appeal. The laws enacted by the assembly, after receiving the sanction of a majority of presbyteries, are the established and permanent statutes of the Church, by which everything belonging to the ecclesiastical state, or to the Church courts, is authoritatively regulated. The United Free Church of Scotland has a General Assembly similar in its constitution and functions to that of the Established Church, and the same is true of the Presbyterian churches (q.v.) of Ireland and America.

Assem'bly, National, a body established in France in 1789. Upon the convocation of the states-general by Louis XVI., the privileged nobles and clergy refused to deliberate in the same chamber with the commons, or *tiers-état* (third estate). The latter, therefore, on the proposition of the Abbé Siéyès, constituted themselves an *Assemblé Nationale,* with legislative powers, 17 June 1789. They bound themselves by oath not to separate until they had furnished France with a constitution, and the court was compelled to give its assent. In the 3,250 decrees passed by the assembly were laid the foundations of a new epoch, and having accomplished this task, it dissolved itself 30 Sept. 1791. The term is also applied to a joint meeting of the Senate and Corps Legislatif, for the purpose of electing a chief magistrate or the transaction of other extraordinary business. See Stephens, 'History of the French Revolution' (1886–91); Doniol, 'La Révolution et la Féodalité' (1874).

As'sen, ä'sĕn, the capital of the province of Drenthe, Holland. Near it are the Giants' Caves, to which Tacitus makes allusion. Pop. 11,191.

Assent', in law, an undertaking to do something in compliance with a request. Approval of something done. Express assent is that which is openly declared. Implied assent is that which is presumed by law. Assent must be to the same thing in the same sense. It must embrace the whole of the proposition, must be exactly equal to its extent and provisions, and must not qualify them by any new matter. Unless express dissent is shown, acceptance of what it is for a person's benefit to take, is presumed, as in the case of a conveyance of land

The Royal Assent is the approbation given by the sovereign in Parliament to a bill which has passed both houses, after which it becomes a law. It may be given in person, when the sovereign comes to the House of Peers and the assent (in Norman French) is declared by the clerk of Parliament; or may be declared by letters-patent under the great seal, signed by the sovereign.

Assess'ment is the determining of the value of a man's property or occupation for the purpose of levying a tax. Determining the share of a tax to be paid by each individual. Laying a tax. Adjusting the shares of a contribution by several toward a common beneficial object according to the benefit received. Assessment of damages includes fixing the amount of damages to which the prevailing party in a suit is entitled. It may be done by the court through its proper officer, the clerk or prothonotary, where the assessment is a mere matter of calculation, but must be done by a jury in other cases. Insurance assessment is an apportionment made in general average upon the various articles and interests at risk, according to their value at the time and place of being in safety for contribution for damage and sacrifices purposely made, and expenses incurred for escape from impending common peril. An assessment is also made upon premium-notes given by the members of mutual fire insurance companies, constituting their capital, and being a substitute for the investment of the paid-up stock of a stock company, the liability to such

assessments being regulated by the charter and by-laws, 12 N. Y. 477; 14 Bart. N. Y. 374.

Asseteague (ăs'sẹ-tēg') **Island,** a small island off the coast of Virginia in Northampton County. Upon it is a lighthouse 150 feet in height.

Assiento, asyän'tō (Spanish, *asiento,* seat, contract, treaty), a term especially applied to an agreement between the Spanish government and a foreign nation to import negro slaves from Africa into the Spanish colonies in America, for a limited time, on payment of certain duties. The English were the sole possessors of this assiento till 1701. In 1713 the celebrated assiento treaty with Britain for 30 years was concluded at Utrecht. By this contract the English, among other privileges, obtained the right of sending a *permission* or *assiento ship,* so called, of 500 tons every year, with all sorts of merchandise, to the Spanish colonies. By the treaty of Madrid, 5 Oct. 1750, the contract was annulled.

As'signa'tion. See ASSIGNMENT.

Assignats, ạ-sẹ-nyạ, or ăs-ĭg-năts, a term applied to the paper money issued during the French Revolution. The French National Assembly after appropriating to national purposes the land belonging to the Church, instead of selling it at a time when its value was greatly depreciated, because of the unsettled state of affairs, issued bonds on the security of it, which were called assignats, as representing land *assigned* to the holder. This paper currency consisted chiefly of notes for one hundred francs each, though many of them were for lower sums. The first issue in 1790 amounted to 400,000,000 francs. The government was relieved by this plan, for the time being the assignats saved the Revolution. This arrangement for relieving the necessities of the government seemed so easy that recourse was repeatedly had to it, as the property of wealthy emigrés, until the amount arose to the vast sum of 46,000,000,000 francs, besides many forged notes. The consequence was that the value of assignats sank to almost nothing. In March 1796, a louis d'or (24 francs) bought 7,200 francs in assignats. They were withdrawn from the currency after this, and redeemed at a thirtieth of their nominal value, by "territorial mandates," a new kind of paper currency, which empowered the holder at once to take possession of public lands at the estimated value, while assignats could only be offered at a sale. These territorial mandates afterward became almost worthless and were returned to the government in payment of taxes or of land. Early in 1797 the system came suddenly to an end.

Assign'ment, a term denoting a transfer by deed of any property, or right, title, or interest in property, real or personal. Assignments are usually given for leases, mortgages, and funded property. In the United States, assignment is of broader signification and applies also to the transfer of real property by certain conveyance. In general, every right of property, real or personal, and every demand connected with a right of property, real or personal; and all choses in action, as bonds, notes, judgments, mortgages, debts, contracts, agreements, relating both to real and personal property, are assignable, and the assignment thereof will pass to the assignee a right of action in the name of such assignee against all parties liable to an action. Assignment carries with it all collateral securities held by the assignor for the collection of a debt or the fulfillment of a contract, and is subject to all the equities and charges which attached in the hands of the assignor. A personal trust, as the right of a master in his indentured apprentice, or the duties of a testamentary guardian, or the office of executor, trustee, etc., is not assignable. The validity of an assignment must be determined by the law of the State in which it was made, provided the thing assigned is subject of municipal or State law; but copyrights, patents, and government claims are governed by acts of Congress. In general, assignments should be recorded in the office prescribed by law, or are void as against those claiming under subsequent assignments. See BANKRUPTCY LAWS.

Assimilation, a term denoting the transformation of foods into living substance. The animal body is constantly changing. New compounds are being made from others; old products are cast off. There is a constant interchange of materials, some building up, others breaking down. The chief factors in the assimilative process are the foods and the oxygen in the air. For a discussion of the former, see DIGESTION; NUTRITION; for the latter, see RESPIRATION. See also METABOLISM.

Assiniboia, ăs-sĭn'ĭ-boi'ạ, a district in northwestern Canada, west of Manitoba, having the district of Saskatchewan on the north and Alberta on the west, and contains an area of 34,000,000 acres. It has a length of about 450 miles east and west by 205 miles north and south. Eastern Assiniboia, for a distance of some 120 miles west from its eastern boundary, is practically a continuation of the grain-growing area of Manitoba, and the soil is productive, producing excellent crops of wheat, coarse grain and vegetables. The main line of the Canadian Pacific Railway (q.v.) extends east to west almost through the centre of Assiniboia, and branch lines extend from Moose Jaw to the southeast corner of the district, and from Regina to the north through the central portion. The Manitoba and Northwestern Railway extends into the northwestern portion of the district from Manitoba, giving good facilities in the way of transportation. Other branches are being projected into southern Assiniboia. The district is well watered by the South Saskatchewan, the Qu'Appelle, Assiniboine, and other rivers, and the valleys along the rivers and creeks are very fertile and generally adapted to mixed farming. Similar conditions prevail in western Assiniboia. A marked development is taking place along the "Soo" line, and the land, which is very fertile, has been largely taken up by settlers from the United States. The principal towns are Regina, the capital, Halbrite, Weyburn, Yellow Grass, Milestone, Rouleau, Moosomin, Grenfell, Wolseley, Indian Head, Qu'Appelle, Saltcoats, Yorkton, and Medicine Hat. Pop. (1904) about 70,000. On 1 Sept. 1905 Assiniboia was united with the province of Saskatchewan and the eastern portion of Athabasca to form the new province of Saskatchewan.

Assin'iboine, a river of Canada, which flows through Manitoba and joins the Red River at Winnipeg, about 40 miles above the entrance of the latter into Lake Winnipeg. It has a somewhat circuitous course of about 500 miles and steamers ply on it for over 300 miles.

Assisi, as-sē'sē, a hill town in Italy, in the province of Umbria, 20 miles from Spoleto. It is the see of a bishop and is famous as the birthplace of Saint Francis, founder of the Franciscan Order, and of Saint Clara, foundress of a religious community for women. The splendid church built over the chapel where Saint Francis received his first impulse to devotion is one of the finest remains of the architecture of the Middle Ages. Pop. (1901) 17,378. See «Assisi» in 'Mediæval Towns Series' (1901).

Assize' of Jerusalem, a code of laws in force in the Christian kingdom of Jerusalem and Cyprus. It consisted of two parts, the assize of the high court with jurisdiction over the nobles, and the assize of the court of burgesses, or code of the common people. It was supposed for some time that the laws were framed by Godfrey de Bouillon; but this is now known to be incorrect. The assize of the high court was first framed as a code about 1255, the assize of the court of Burgesses, in the latter part of the 12th century, but the exact date is uncertain.

Assiz'es, an English legal term signifying the sessions of the courts held at intervals in every country by the judges. The whole country is divided into circuits, and three times in the year two judges, who are members of the highest courts in England, hold assizes in all the counties of their respective circuit. In London and Middlesex, instead of circuits, what are known as courts of *nisi prius* are held. At the assizes all the justices of the peace of the county are bound to attend, or else are liable to a fine; and also all the persons who have been summoned as grand jurymen or petit jurymen by the sheriff. At these assizes the judges sit under five separate commissions, some of which relate to civil and some to criminal causes or business. In this manner, and by these means, the jails are in general cleared, and offenders tried and convicted or acquitted at least every half year. In America there are no courts or sessions of courts technically called assizes. The judges, however, perform the same duties in the counties, within their respective circuits and jurisdictions, as the English judges, and generally in the same manner, that is to say, according to the course of the common law. Since 1808 there have been assize courts in the judicial system in France. With the English institutions, however, they have scarcely anything in common but the name. In the law of Scotland assize is the technical term applied in cases tried in the court of justiciary to the jury of 15 sworn men, selected by ballot from a greater number not exceeding 45.

Asso'ciated Press. See PRESS ASSOCIATIONS.

Association Areas. In the brain of many lower animals as well as in that of man there are definite areas associated with other areas by sets of fibres, known as association fibres. These different areas act together in performing many of the complicated acts of human life. Thus, the general sensory area in the brain, that feels the skin sensations and determines their character, is in close association with the motor area determining the movements of the body in correspondence with the knowledge given by the sensory areas. Under the heading APHASIA several of these association areas are discussed. The studies of psychology and of mental diseases are largely concerned with the relations and connections of the association areas in the brain.

Bibliography.— Flechsig, 'Die Gehirn und Seele' (1896); Barker, 'Journal of Nervous and Mental Disease,' 1897, pp. 326–356.

Association Fibres, a term applied to those fibres that connect different parts of the brain, particularly those that unite different areas in the same hemisphere, distinguishing them from the commissural fibres that connect areas in different hemispheres, or projection fibres that bind the cerebrum with the lower cerebellar or spinal systems. These association fibres form late in childhood and on their development depends much of the increased intellectual growth of the individual.

Association of Ideas, a phrase current in philosophy and psychology since the days of John Locke. The term «association» has had, in this connection, many different meanings. In popular psychology, it indicates the way the mind passes from idea to idea; or the way one idea suggests or «reproduces» another. Thus, in passing from the thought of gold to the recollection of a recent visit to a mining camp and then to the plot of a novel laid in a mountainous region, one may be said to «associate» the story with the idea of the mining camp, and this, in turn, with the idea of gold. (See MEMORY.) It is but a step from this popular conception of association — association as «reproduction»— to the notion that association is an explanation of reproduction. Association then becomes (to change the figure) not the actual passage from idea to idea, but the intangible bond which holds ideas together and which enables one idea (that is, the «gold» idea) to drag after it another (the «camp» idea). This second interpretation of the term is in disrepute among psychologists because no evidence of such a bond as the interpretation implies is to be found in consciousness. It may be urged, however, that even if association in this causal sense be undiscoverable by introspection it may, nevertheless, be regarded as a general principle of mental activity; — as the means by which the mind creates knowledge. When, however, association is thus interpreted to mean a principle underlying and conditioning the process of knowing it passes from psychology to epistemology. (See PSYCHOLOGY.) The doctrine of Associationism, which is connected with the names of David Hume, James Mill, Alexander Bain and other «associationists,» rests upon this epistemological meaning of the term.

Returning to the psychological use of the word «association,» we may note that the popular conception stands in need of modification and precision. (1) To say that mind «associates» idea with idea implies that ideas are by nature

separate and distinct and require some "gentle force" (as Hume puts it) to bring them together. This is not true. Ideas are interwoven; they are organically connected; they are not held together as in a bundle. (2) In the second place, the popular use of the term is too narrow; a chain of actions, or of emotions, or of feelings, may be associated as well as a chain of ideas. In habitual performances, for example,— such as dressing — one act calls forth the next, this in turn the next, and so on; or emotion may be linked with emotion, as anger following fear; or, finally, associations may set out from a perception, as the thought of home from the sight of a letter. (3) Again, association does not necessarily imply a sequence of associated elements. It may be simultaneous, as well as successive; for example, I see the table before me and, at the same time, I apprehend it as a hard resisting substance, or I hear the rumble of a carriage behind me and I see, in my "mind's eye," its form and color. (See PERCEPTION.) (4) Finally, association in the popular sense simply states that idea follows idea; it tells us nothing of the nature of the associated consciousness; of how, that is, an association differs from a perception. Now association, in its strict technical sense, means the associated elements of consciousness; to illustrate, it means the mass of constantly shifting processes which make up mind while one is thinking gold — mining-camp — novel. Just as there exist typical groups of mental processes which underlie the perception of a landscape, a swinging pendulum or a musical composition, there exist other typical groups — such as those already mentioned — which are known as associations.

Psychological work upon association has been directed, for the most part, upon the conditions under which associative groups arise. These conditions have, since the days of Aristotle, been set down under the heading of "principles" or "laws" of association. Thus *a* is said to call up or reproduce *b* when *a* and *b* have, at some previous time, stood together in consciousness (law of contiguity), or when *a* has been the cause of *b* (law of causality), or when *a* resembles *b* (law of similarity), etc. At the present time, these "laws" of association are usually reduced to two; the law of contiguity and the law of similarity. But even these are by no means final or adequate statements of the conditions under which associations arise; for — to point to only two or three of their imperfections —"similarity" is an extremely ambiguous term; it may mean simple likeness, or partial identity, or likeness of relationship; and "contiguity" is indefinite — it does not determine how near processes must lie in consciousness in order for one to reproduce the other. Moreover, it should be said that there are thousands of contiguity and similarity connections that are never realized in association; this follows from the fact that almost everything is, to some extent, similar to everything else, and that the elementary processes of mind have appeared "contiguously" in almost every conceivable form of combination. Both terms are, then, too broad to have much significance. If we set them down as "laws," we have still to determine under what particular conditions a given association is formed. Many of these particular and more important conditions have been determined; they include recency, frequency, vividness (the more recently or frequently or vividly a process or group of processes has stood in consciousness the greater the liability of its appearing in an associative connection), the general interests of the individual mind (for example, botanical ideas crop up in the botanist's mind, geological ideas in the mind of the geologist), the presence or absence of inhibitory associations (if *a* has already stood associated with *b* and *c*, its chances for associating with *d* will be lessened), mood (unpleasant subjects crowd into mind when one is depressed), etc. The actual liability of a given association being formed is thus seen to rest upon a great number of possible conditions. So far as there is any truth in a general all-inclusive "law" of association it is best expressed as a law of neural habit. This law is formulated by W. James as follows: "when two elementary brain-processes have been active together or in immediate succession, one of them, on reoccurring, tends to propagate its excitement into the other." The relation of this law to the law of contiguity is obvious.

Consult: James, 'Principles of Psychology' (1890), ch. xiv.; Titchener, 'Experimental Psychology,' pt. II. (1901), 402; Kuelpe, 'Outlines of Psychology' (trans. 1895), 177ff; Calkins, 'Introduction to Psychology' (1901), 157ff.

I. M. BENTLEY,
Assistant Professor of Psychology, Cornell University.

Associa'tion for the Protection of the Adirondacks, a society organized in 1902 and incorporated the same year for the purpose of preserving the forests, waters, game, and fish, and to maintain healthful conditions in the Adirondack region.

Assollant, as'sō'län', **Alfred,** a French novelist and political writer; b. Aubusson, 20 March 1827; d. Paris, March 1880. Having traveled extensively over the United States, he published, on his return, 'Scenes from Life in the United States' (1858), a series of tales which attracted a good deal of attention. Among his numerous novels are 'Two Friends in 1792' (1859), a story of the Reign of Terror; 'Brancas' (1859), a picture of the corruption under Louis Philippe; 'Gabrielle de Chênevert' (1865), portraying the provincial nobility before the Revolution; 'Pendragon' (1881), and 'Plantagenet' (1885).

Assommoir, L', la'sō'mwär', a novel by Emile Zola, entitled 'Gervaise' in the English translation, published in 1877. It forms one of the series dealing with the fortunes of the Rougon-Macquart family, and is a series of repulsive pictures unrelieved by one gleam of a nobler humanity, but only "realistic" as scraps: the life as a possible whole is as purely imaginative as if it were lovely instead of loathsome.

As'sonance, in poetry, a term used when the lines end with the same vowel-sound, but make no proper rhyme. Such verses having what we should consider false rhymes are regularly employed in Spanish poetry; as in *ligera, cubierta, tierra, mesa.*

Assos, ăs'ŏs, an ancient Hellenic port on the Gulf of Edremid, from whose still imposing remains the successful excavations, in 1881–3, of the American Institute of Archæology have brought to light the agora, with senate house and colonnade, a bath, theatre, gymnasium, statues of heroes, and seven Christian churches.

Assouan, a-swän', or **Assuan**, also called Eswan (Arabic *al suaan*, "the opening," that is, of the Nile; the ancient Syene, whence the red granite of the vicinity — from whose famous quarries were cut under the earliest dynasties so many of the huge obelisks and colossal statues that adorned the temples and palaces of Egypt — is called syenite), the southernmost city of Egypt proper, near Nubia, on the right or eastern bank of the Nile, and beside the first or lowest cataract. Near it are the islands of Philæ and Elephantine, the ruined monuments of the former of which are of such fascination to tourists; on the left bank are many rock tombs of the ancient dynasties. It is a garrison town, the central depot for the Sudan caravan trade, and the terminus of a railway to Alexandria which enhances its prosperity. Of still greater importance is the new dam which will add several hundred square miles outright to the arable soil of Egypt, besides steadying the fertility of the older lands, and which is described *in extenso* below. Pop. about 10,000, including the suburbs.

The monumental dam at Assouan, by far the greatest achievement of the kind in ancient or modern times, forms a reservoir in the Nile valley capable of storing 1,000,000,000 tons of water. It will not only produce a revolution in the primitive and laborious methods of irrigation in Egypt, but will reclaim vast areas of land that have hitherto been accounted as arid and worthless. The old system of irrigation was little more than a high Nile flooding of different areas of land or basins surrounded by embankments. Less than a hundred years ago, the introduction of perennial irrigation was first attempted by cutting deep canals to convey the water to the lands when the Nile was at its low summer level. When the Nile rose, these canals had to be blocked by temporary earthen dams, or the current would have wrought destruction. As a result, they silted up, and had to be cleared of many millions of tons of mud each year by enforced labor, much misery and extortion resulting therefrom. About half a century ago the first serious attempt to improve matters was made by the construction of the celebrated Barrage at the apex of the delta. This work consists, in effect, of two brick-arched viaducts crossing the Rosetta and Damietta, branches of the Nile, having together 132 arches of 16 feet 4 inches span, which were entirely closed by iron sluices during the summer months, thus heading up the water some 15 feet and throwing it at a high level into the six main irrigation canals below Cairo. In the summer months the whole flow of the Nile is arrested and thrown into the aforesaid canals. The old Barrage was constructed under great difficulties by French engineers, subject to the passing whims of their Oriental chiefs. About 15 years elapsed between the commencement of the work and the closing of all the sluices, and another 20 years before the structure was sufficiently strengthened by British engineers to fulfil the duties for which it was originally designed. Forced labor was largely employed in its construction, and at one time 12,000 soldiers, 3,000 marines, 2,000 laborers, and 1,000 masons were at work at the old Barrage.

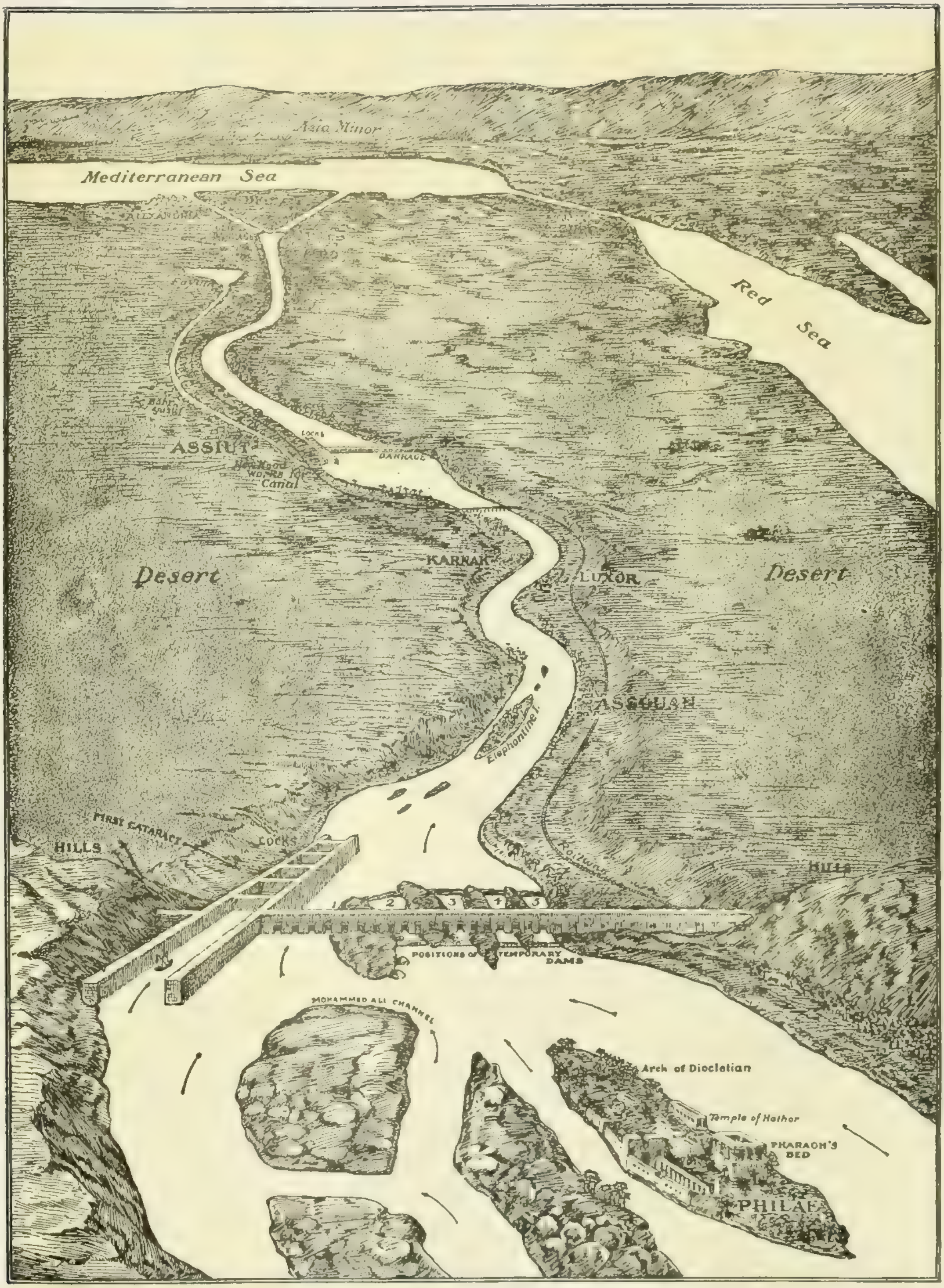
In connection with the Nile reservoir, subsidiary weirs were constructed below the old Barrage to reduce the stress on that structure. The system adopted was a novel one, devised by Major Brown, inspector-general of irrigation in lower Egypt. His aim was to dispense almost entirely with plant and skilled labor; and so, without attempting to dry the bed of the river, he made solid masonry blocks under water by grouting rubble dropped by natives into a movable timber caisson. Both branches of the Nile were thus dammed in three seasons, at a cost, including navigation locks, of about $2,500,000. Many other subsidiary works have been and will be constructed, including regulators, such as that on the Bahr Yusuf canal. The most important of the works is the Barrage across the Nile at Assiout, about 250 miles above Cairo, which was commenced by Sir John Aird & Co. in the winter of 1898 and completed in 1902. The great dam at Assouan, 850 miles above Cairo, is not a solid wall, but is pierced with sluice openings of sufficient area for the flood discharge of the river, which may amount to 15,000 tons of water per second. There are 180 such openings, mostly 23 feet high by 6 feet 6 inches wide; and where subject to heavy pressure when being moved they are of the well-known Stoney roller pattern. The total length of the dam is about 1¼ miles; the maximum height from foundation, about 130 feet; the difference of level water above and below, 67 feet; and the total weight of masonry over 1,000,000 tons. Navigation is provided for by a "ladder" of four locks, each 260 feet long by 32 feet wide. As was the case at Assiout, the difficulties in dam construction are not in design, but in the carrying out of the works. When the "rotten rock" in the bed was discovered, Sir Benjamin Baker reported to Lord Cromer frankly that he could not say what the extra cost or time involved by this and other unforeseen conditions would be, and that all that could be said was that, however bad the conditions, the job could be done. Lord Cromer replied that the dam had to be completed whatever the time and cost involved. The contract was let to Sir John Aird & Co., of London, with Messrs. Ransomes and Rapier, of London, as sub-contractors for the steel work, in February 1898. Two months after signing the contract the permanent works were commenced, and before the end of the year thousands of native laborers and hundreds of Italian granite masons were hard at work. On 12 Feb. 1899, the foundation stone of the dam was laid by the Duke of Connaught. Many plans were considered by the engineers and contractors for putting in the foundations of the dam across the roaring cataract channels, and it was finally decided to form temporary rubble dams across three of the channels below the site of the great dam, so as to break the force of the torrent and get a pond of comparatively still water up stream to work in. Stones of from 1 ton to 12 tons in weight were tipped into the cataract, till finally a rubble mound appeared above the surface. The first channel was successfully closed on 17 May 1899, the depth being about 30 feet and the velocity of current nearly 15 miles an hour. In the case of another channel the closing had to be helped by tipping in railway cars themselves, loaded with heavy stones and bound together with wire ropes, making a mass of about 50 tons, the great mass being necessary to resist displacement by the torrent.

These rubble dams were well tested when the high Nile ran over them; and on work being resumed in November, after the fall of the river, water-tight sandbag dams, or "sudds," were made around the site of the dam foundation in the still waters above the rubble dams, and pumps were fixed to lay dry the bed of the river. This was the most exciting time in this stage of the operations, for no one could predict whether it would be possible to dry the bed, or whether the water would not pour through the fissured rock in overwhelming volume. Twenty-four 12-inch centrifugal pumps were provided to deal, if necessary, with one small channel; but happily the sandbags and gravel and sand embankments stanched the fissures in the rock and interstices between the great boulders covering the bottom of this channel, and a couple of 12-inch pumps sufficed. The masonry of the dam is of local granite, set in British Portland cement mortar. The interior is of rubble set by hand, with about 40 per cent of the bulk in cement mortar, four of sand to one of cement. All the face work is of coursed rock-faced ashlar, except the sluice linings, which are finely dressed. This was steam crane and Italian masons' work. There was a great pressure at times to get a section completed before the inevitable rise of the Nile, and as much as 3,600 tons of masonry was executed per day, chiefly at one point in the dam. A triple line of railway and numerous cars and locomotives were provided to convey the materials from quarries and stores to every part of the work. The maximum number of men employed was 11,000, of whom 1,000 were European masons and other skilled men. Mr. Wilfred Stokes, chief engineer and managing director of Messrs. Ransomes and Rapier, was responsible for the detailed designing and manufacture of the sluices and lock gates; 140 of the sluices are 23 feet high by 6 feet 6 inches wide, and 40 of them half that height; 130 of the sluices are on the "Stoney" principle with rollers, and the remainder move on sliding surfaces. The larger of the Stoney sluices weigh 14 tons, and are capable of being moved by hand under a head of water producing a pressure of 450 tons against the sluice. There are five lock gates, 32 feet wide, and varying in height up to 60 feet. They are of an entirely different type from ordinary folding lock gates, being hung from the top on rollers, and moving like a sliding coach-house door. This arrangement was adopted for safety, as 1,000,000,000 tons of water are stored up above the lock gates, and each of the two upper gates is made strong enough to hold up the water, assuming that the four other gates were destroyed. When the river is rising the sluices will all be open, and the red water will pass freely through, without depositing the fertilizing silt. After the flood when the water has become clear, and the discharge of the Nile has fallen to about 2,000 tons per second, the gates without rollers will be closed, and then some of those with rollers; so that between December and March the reservoir will be gradually filled. The reopening of the sluices will take place between May and July, according to the state of the Nile and the requirements of the crops. Between December and May, when the reservoir is full, the island of Philæ will in places be slightly flooded. As the temples are founded partly on loose silt and sand, the saturation of the hitherto dry soil would cause settlement, and no doubt injury to the ruins. To obviate this risk, all the important parts, including the well-known Kiosk, or "Pharaoh's bed," have been either carried on steel girders or underpinned down to rock; or failing that, to the present saturation level. It need hardly be said that having regard to the shattered condition of the columns and entablatures, the friability of the stone, and the running sand foundation, the process of underpinning was an exceptionally difficult and anxious task. It is impossible to estimate the far-reaching beneficial influence these irrigation works will bestow upon Egypt; but the reclamation of so many thousands of acres of desert for agricultural development cannot fail to improve the agricultural possibilities of the land, and assist Egypt to regain the prosperity it enjoyed in the era of the Pharaohs, with a greater cultivable area than it had even then. See Irrigation; Nile.

Assump'sit, in law, an action to recover a compensation in damages for non-performance of a simple contract; that is, a promise, whether verbal or written, not contained in a deed under seal. The word *assumpsit* (Latin) means, he undertook, and was taken as the name of this action from its occurrence in declarations, that is, formal statements of the plaintiff's cause of action, when these were in Latin. Assumpsits were of two kinds, *express* and *implied;* the former being where the contracts were actually made in word or writing; the latter being such as the law implies from the justice of the case; as, for instance, if one is employed to perform service or labor, the obvious justice of paying him a reasonable sum therefor when completed raises an implication, in law, of a promise to make such payment.

Assump'tion, a city in Paraguay. See Asuncion.

Assump'tion, a Church festival celebrating the translation into heaven of the Virgin Mary, kept on 15 August. The legend first appeared in the 3d or 4th century, and the festival was instituted some three centuries later. The story has been made the subject of a number of paintings by the most celebrated artists in history. The following are the best known: (1) Titian: in the Accademia in Venica; represents the Virgin being carried on bright clouds to heaven, surrounded by rejoicing angels, while the apostles look up from earth in amazement; (2) Titian: another painting in the Cathedral of Verona; (3) Correggio: frescoes in the cupola of the cathedral in Parma, Italy; (4) Rubens: painting in the cathedral at Antwerp, Belgium; representing the Virgin being carried to heaven, surrounded by angels, while several apostles and women are gathered at the empty tomb below; (5) Perugino: in the Accademia, in Florence; showing, in addition to the Virgin, four saints in the foreground; the representation of the Virgin is considered one of Perugino's most beautiful figures; (6) Guido Reni: a large canvas in Bridgewater House, in London; (7) Gaudenzio Ferrari: fresco in the Church of San Cristoforo, in Vercelli, Italy; showing figures of the Father, the Virgin, the angels, and the apostles; (8) Murillo: painting in the Hermitage Museum, St. Petersburg; representing the Virgin floating



ASSOUAN DAM.

Bird's-eye View of the Structure and Surrounding Region.

upward on clouds, with bands of cherubs above and below her; (9) Guercino: a painting, also in the Hermitage Museum; showing the Virgin, with uplifted face, being borne upward on a cloud, with angel attendants, and the apostles standing about her empty tomb. ‘The Assumption of Moses’ is the title of an apocryphal book, giving an account of the reception of Moses in heaven, written probably 20 A.D.

Assurance, Sisters of the, a teaching Order of Sisters in the Catholic Church, founded by Monsignor Affre in Paris in 1839.

Assu'rance. See INSURANCE.

Assurbanipal, äs'soor-bä'ne-päl'. See ASSYRIA; NINEVEH; SARDANAPALUS.

As'sus. See ASSOS.

Assynt, ăs'ĭnt, a wild and rugged district of Scotland. There are inexhaustible quarries of marble, both white and variegated. Fresh-water lakes are numerous; the largest, Loch Assynt, is about seven miles in length and one mile in breadth.

Assyr'ia (the *Asshur* of the Hebrews, *Athurâ* of the ancient Persians), the ancient name of a portion of Mesopotamia, lying mainly between the Euphrates and the Tigris, the seat of the earliest recorded monarchy. In the earliest times it was probably limited to the low-lying tract between the Jebel Makloub and the little Zab (Zab-Asfal), on the left bank of the Tigris; but at its greatest extent Assyria must have been nearly 500 miles long, with an area of about 100,000 square miles. Toward the north Assyria bordered on the mountainous country of Armenia, which may at times have been under Assyrian dominion, but which at no time was considered as an actual part of the country. On the east dwelt numerous independent and warlike tribes, sheltered by the fastnesses of the Zagros Mountains. On the south Susiana or Elam was the frontier state east of the Tigris, while Babylonia occupied the same position between the rivers. West of Assyria lay Arabia, and higher up Syria and the land of the Hittites. The chief cities of Assyria in the days of its greatest prosperity were Ninevah, whose site is marked by the mounds opposite Mosul (Nebi Yunus and Koyunjik), Calah or Kalakh (the modern Nimrud), Asshur or Al Asur (Kalah Sherghat), Sargina, Khorsabad), Arbela (Arbil), etc. The surface of the country within its widest limits was of a diversified character. On the north and east the lofty mountain-ranges of Armenia and Kurdistan are succeeded by low ranges of arid limestone hills, occasionally enclosing fertile plains and valleys. Immediately south of this is a well-watered, productive, and undulating belt of country, into which run limestone rocks of a golden color, and wooded with dwarf-oak. This sinks suddenly down upon the great Mesopotamian plain (the modern El Jezireh), about 250 miles in length, interrupted only by a single limestone range rising suddenly out of the plain and branching off from the Zagros Mountains. The numerous remains of ancient habitations show how thickly this vast flat must have once been peopled; now, for the most part, it is a mere wilderness.

History.— Scripture tells us that the early inhabitants of Assyria went from Babylon, and the traditions of later times, as well as inscriptions on the disinterred Assyrian monuments, and the character of those remains, go to show that the power and civilization of Babylon were earlier than those of Assyria. In Genesis x. 11 it is mentioned that Nineveh was founded by Asshur, but for long the country was subject to governors appointed by the kings of Babylon. We learn from monumental inscriptions that about 1820 B.C., when Asshur was the capital of the country, Samsi-vul founded temples there to Asshur, the great national deity, and to Anu and Vul, besides a temple to the goddess of Nineveh in the city of that name. The Assyrian rulers gradually began to treat with their southern neighbors on equal terms, the boundaries of the two countries were for a time clearly marked out, and intermarriages among the reigning families occasionally took place. About the latter end of the 14th century Shalmaneser acquired the whole of Naharain (the country round the sources of the Euphrates and Tigris) by conquest, and planted Assyrian colonies there; he also founded the city of Kalakh or Calah, and restored the great temple at Nineveh. About 1300 B.C. he was succeeded by his son Tiglath-ninip, who conquered the whole of the valley of the Euphrates, and built or restored the palace at Asshur. The five following reigns were occupied with wars, more or less successful, with the Babylonians. About the year 1120 B.C. Tiglath-Pileser I., one of the most eminent of the sovereigns of the first Assyrian monarchy, ascended the throne, beginning his reign by the conquest of the Syrians and Hittites in the west. He then carried his arms far and wide, subjugating the Moschians, Commagenians, Urumians, and other tribes in the north; on the south he shattered the Babylonian power, and captured their capital. But this empire, acquired and ruled by the energy and genius of one man, began to fall to pieces at his death (1100). The period of decline lasted over 200 years, during which time little is known of Assyrian history. Under Assur-nazir-pal, who reigned from 884 to 859 B.C., Assyria once more advanced to the position of the leading power in the world. The extent of his kingdom was greater than that of Tiglath-Pileser, and the magnificent palaces, temples, and other buildings erected during his reign, with their elaborate sculptures and paintings, prove that wealth, art, and luxury must have reached a high stage of development. When he ascended the throne Nineveh was the capital of the kingdom, but he restored and beautified Calah, which had suffered during the troubled and declining years of the country, made it his favorite residence, and raised it to the dignity of the chief city of the state. Among the first acts of his reign was the suppression of a revolt by the Assyrian colonists of Naharain (883). This was followed by the victorious campaigns in Zamua on the eastern frontier (882–881), against several rebellious provinces in the northwest (880), and against the Shukhi or Shuhites, who then occupied a tract of country between Babylon and Assyria (879). In another expedition he crossed the Euphrates and advanced to the Mediterranean, near the mouth of the Orontes. In 859 Assur-nazir-pal was succeeded by his son Shalmaneser II., whose career of conquest was equally successful. The closing years of his reign were troubled by the re-

bellion of his eldest son, Assur-dain-pal, who had gained over to his side the cities of Nineveh, Assur, Arbela, and other important towns. After much fighting the rebellion was put down by Shalmaneser's second son Samsi-vul (Samas-Rimmon), who succeeded to the throne in 824. The old dynasty came to an end in the person of Assurnirai II., who was driven from the throne by a usurper, Tiglath-Pileser, in 745, after a struggle of some years. No sooner was this able ruler firmly seated on the throne than he made an expedition into Babylonia, followed by another to the east in 744. In the following year an alliance was formed against Assyria between Sarduri, king of Armenia, and several neighboring princes, and the Syrians came to their assistance at Arpad, on the Euphrates. Here they were defeated with great slaughter by Tiglath-Pileser, and the Armenian king was chased to the gates of his capital, Turuspa. The conqueror now advanced against Syria, overthrew the ancient kingdoms of Damascus and Hamath, and placed his vassal Hosea on the throne of Samaria. A protracted campaign in Media (737-735), another in Armenia, and the memorable expedition into Syria mentioned in 2 Kings xvi., are among the most important events of the latter years of his reign. Tiglath-Pileser was one of the greatest of the Assyrians; he carried the Assyrian arms from Lake Van on the north to the Persian Gulf on the south, and from the confines of India on the east to the Nile on the west. Yet he was not able to keep his seat on the throne, being driven from it by another claimant named Shalmaneser (727). Little is known of the five years' reign of this prince. He blockaded Tyre for five years, and on the revolt of Hosea, king of Israel, in league with Sabako, king of Egypt, he invaded Israel and besieged Samaria, but died before the city was reduced. His successor Sargon (722-705) claimed descent from the ancient Assyrian kings. At the very opening of his reign, after taking Samaria and leading over 18,000 people captive, he overthrew the combined forces of Elam (Susiana) and Babylon. In 719 Sargon turned his arms against the revolted Armenians, and in 717 he besieged and took the rich trading city of Carchemesh, which had also risen against his authority; here an immense spoil fell into his hands. In 716 the Armenians and several tributary princes in the north again took up arms for independence, but the Assyrians having again triumphed the Armenian king committed suicide and the other princes submitted. The attitude of Babylonia now began to look extremely dangerous. Merodach-Baladan, a Chaldæan leader, taking advantage of the troubles which closed the reign of Tiglath-Pileser, had possessed himself of Babylonia, and held it for 12 years, strengthening himself by alliances with Egypt and the various rulers of Palestine. In 710 Merodach-Baladan was driven out of Babylonia; in a single campaign the allies were crushed, Judah was overrun, and Ashdod leveled to the ground. Sargon spent the latter years of his reign in internal reforms, and in founding or beautifying several cities of his kingdom. A new city, called Dur-Sargina, was founded to the north of Nineveh, the library of Calah was restored and enlarged, and special attention was devoted to law reform. In the midst of these labors Sargon was murdered, and was succeeded by Sennacherib, one of his younger sons, in 705.

No sooner was Sennacherib seated on the throne than he was compelled to take up arms against Merodach-Baladan, who had again obtained possession of Babylon. In 701 fresh outbreaks in Syria led him in that direction. He first swept down on Zidon, drove the king into Cyprus, and seated Tubal on his empty throne. Next he deposed Zidqa of Askelon, and advanced against Ekron and Judah. The people of Ekron had dethroned Padi their king. and gave him into the hands of Hezekiah, king of Judah. The Egyptian and Ethiopian forces advanced to the assistance of their Judean allies, but Sennacherib totally routed the confederates at Altaqa in Judah, which he rapidly overran, taking 46 of its fortified cities. Hezekiah now submitted, agreeing to pay the conqueror a sum of 30 talents of gold and 800 talents of silver. Padi was given up and restored to Ekron, and after Sennacherib had chastised the rebels he returned to Assyria. The threatening aspect of affairs in Babylonia and Elam again called his attention to the south in 700, and in 699 he advanced to the northern boundaries of his kingdom to quell the insurrections which had broken out among the hill tribes. His second expedition into Syria is one of the most memorable in the history of Assyria, and is briefly recorded in 2 Kings xix. But his career of conquest was stopped by an appalling catastrophe: his army lay before Libna, when in one night "the angel of Jehovah went out and smote in the camp of the Assyrians 185,000 men" (2 Kings xix. 35). Sennacherib himself returned to Assyria, and occupied the last years of his reign in repressing the outbreaks of the Babylonians and Elamites, in constructing canals and aqueducts, and in entirely rebuilding Nineveh. In 681 he was murdered by his two sons, Adrammelech and Sharezer, but they soon found themselves confronted by a veteran army under Esar-haddon, their father's younger and favorite son, who defeated them in a battle at Kanirabbat, and assumed the crown (680).

Esar-haddon fixed his residence at Babylon, where he governed in person during the whole of his reign. The most important event of this reign was the conquest of Egypt, which left Assyria the mistress of the world. In 672 Esar-haddon led his forces into Egypt, drove out Tirhakah, its Ethiopian ruler, and divided the land into 20 separate kingdoms, the rulers of which were his vassals. Feeling unable to cope in person with his rebellious tributaries, Esar-haddon associated his son Assurbani-pal with him in the government of the kingdom (669), dying two years later. But constant wars were beginning to exhaust the men and treasure of the empire; and luxury, which had flowed suddenly in like a flood, was enervating the people. The king now no longer appeared at the head of his army, but intrusted it to generals, and abandoned himself to indolence and sensuality. Assurbani-pal was a zealous patron of the arts; learned men fom all countries were welcomed to his court; literary works were collected from all sources; the library of Nineveh was greatly augmented; the study of the dead language of Accad was encouraged, and dictionaries and grammars were compiled. The buildings were unrivalled for magnificence, his palace glittering with gold

and silver, and adorned with the rarest sculptures. Unfortunately the king's character was marked by cruelty and sensuality, and his example descended through the court to the people. He died in 625, and was succeeded by his son Assurebilili-kain, under whom Babylon definitely threw off the Assyrian yoke. The country continued rapidly to decline, fighting hard for mere existence until, under its last king Sarcus, Nineveh was captured and burned by the allied forces of the Medes and Babylonians in 606 B.C.

Ethnology, Language, Religion, etc.—The original inhabitants of Assyria and Babylonia belonged to that race variously called Turanian, Ural-Altaic, Scythian, or Tatar, and which appears at one time to have occupied the entire region from the Caucasus to the Indian Ocean, and from the Mediterranean to the delta of the Ganges. The ancient Assyrians, therefore, were of the same stock as that from which the Finns, Turks, and Magyars have descended; and their language, which has been preserved to us in inscriptions, and is known by the name of Accadian, is allied to the Ugro-Bulgaric division of the Finnic group of languages. The Akkadai or Accad race descended from the mountainous region of Elam on the east, and the origin of Chaldæan civilization and writing was due to them. In course of time, however, a Semitic race of people spread themselves over the country, and mingled with or supplanted the original inhabitants, while their language took the place of the Accadian, the latter becoming a dead language. Belonging to the Semitic family, these later Assyrians were thus members of the same great division of the human race as the Hebrews, Syrians, Phœnicians, and modern Arabians. The language differed little from the Babylonian, which was characterized by a preference for the softer sounds and a fuller use of the vowels. Both languages retained traces of the influence of the earlier Accadian. Assyrian is closely allied to Hebrew and Phœnician; it has their peculiarities of phonology, vocabulary, and grammar, and some obscure points in Hebrew etymology have been cleared up by its aid. The language changed little throughout the 1,500 years during which we can trace its career in the recently deciphered inscriptions. It continued to be written with the cuneiform character down to the 3d century B.C. Assyria could boast of but little native literature; it was a land of warriors, and the peaceful arts had their home in Babylonia. It was not until the time of Assur-bani-pal that any attempt was made to rival Babylon in learning. Their original works were for the first time composed, and treaties were composed even, in the dead Accad language. The greater part of the literature was stamped in minute characters on baked bricks, but papyrus was also used, although no books in this form have come down to us. The subjects of the Assyrian literature comprise hymns to the gods, mythological and epic poems, and works on history, chronology, astrology, law, etc. (See BABYLONIAN LITERATURE.) The Assyrian religion, like the language and arts, was in most essential points derived from Babylonia. There were the same gods, the same ceremonials and prayers, and even the temples had the same names. There is, however, in one point a notable difference. In addition to the worship of the Babylonian deities the Assyrians adored their national deity Assur, placing him at the head of the Pantheon. He was called king of all the chief gods, the god who created himself, it being supposed that he was self-existent and the creator of all things. After Assur come the 12 chief deities, Anu, god of heaven, ruler of angels and spirits; Bel, the father of the gods; Hea, king of the sea; Sin, or the Moon, lord of crowns; Shamas, or the Sun, judge of heaven and earth; Ninip, god of hunting; Nergal, god of war; Nusku, bestower of sceptres; Beltis, mother of the gods; Ishtar, leader of heaven and earth; and Bel, or Merodach, lord of Babylon. Most of those divinities had consorts, who were not, however, admitted to the first rank of the gods. Below this first rank were a number of spirits, good and evil, who presided over the minor operations of nature. There were set forms regulating the worship of all the gods and spirits, and prayers to each were inscribed on clay tablets with blanks for the names of the persons using them.

Art and Science, etc.—Although in art, as in other things, Assyria was the pupil of Babylon, there was yet a notable difference between its development in the two countries, due partly to two causes. The alabaster quarries scattered over the country supplied the Assyrians with a material unknown to their southern neighbors, on which they could represent, far better than the Babylonians on their enamelled bricks, the scenes which interested them. Sculpture was naturally developed by the one, just as painting was by the other, and the ornamentation which could be lavished on the exterior of buildings in Assyria had to be confined to the interior in Babylonia. The Assyrian artists, faithful and indefatigable, acquired a considerable power in representing the forms of men and animals, and produced vivid and striking scenes of the chief occupations of human life. If they did not strive greatly after the ideal, and never in this direction reached a very exalted rank, yet even here their emblematic figures of the gods have a dignity and grandeur which implies the possession of some elevated feelings. But their grand merit is in the representation of the real. Their scenes of war and of the chase, and even sometimes of the more peaceful incidents of life, have a fidelity, boldness, and lifelike appearance which place them high among the realistic schools. Unlike that of the Egyptians, which remained comparatively stationary from the earliest to the latest ages, the art of the Assyrians is plainly progressive, becoming gradually more natural and less uncouth, more lifelike and less stiff, more varied and less conventional. It may be said to have reached its highest stage of development in the reign of Assur-bani-pal, when it was characterized by great chasteness and softness, delicacy and finish. The beginning of Greek art coincides with the decadence of the Assyrian, and there can be no doubt that the Hellenic artists owe much to their Assyrian predecessors. The advanced condition of the Assyrians in various other respects is sufficiently evidenced by the representations on the sculptures, and by the remains discovered among their ruined buildings. We now know that they understood and applied the arch; that they constructed tunnels, aqueducts, and drains; that they used the lever and the roller; that they engraved gems in a highly artistic way; that they understood the arts of inlaying, enamelling, and

overlaying with metals; that they manufactured porcelain, and transparent and colored glass, and were acquainted with the lens; that they possessed vases, jars, and other dishes, bronze and ivory ornaments, bells, gold earrings and bracelets of excellent design and workmanship. Their household furniture also gives us a high idea of their skill, taste, minuteness, and accuracy. The cities of Nineveh, Assur, and Arbela had each their royal observatories, superintended by astronomers-royal, who had to send in their reports to the king twice a month. At an early date the stars were numbered and named; a calendar was formed, in which the year was divided into 12 months (of 30 days each) called after the zodiacal signs, but as this division was found to be inaccurate an intercalary month was added every six years. The week was divided into seven days, the seventh being a day of rest; the day was divided into 12 *casbu* of two hours each, each casbu being subdivided into 60 minutes, and these again into 60 seconds. Eclipses were recorded from a very remote epoch, and their recurrence roughly determined. The principal astronomical work, called the Illumination of Bel, was compiled for the library of Sargon of Agane; it was inscribed on 70 tablets, and went through numerous editions, one of the latest being in the British Museum. It treats, among other things, on observations of comets, the polar star, the conjunction of the sun and moon, and motions of Venus and Mars. The study of mathematics was fairly advanced, and the people who were acquainted with the sundial, the clepsydra, the pulley, and the lever must have had considerable knowledge of mechanics. See ASSYRIOLOGY.

Government.—Like all the ancient monarchies which attained to any considerable extent, Assyria was composed of a number of separate kingdoms. In the East conquest has very seldom led to amalgamation, and in the primitive empires there was not even any attempt at that governmental centralization which we find at a later period in the satrapial system of Persia. The Assyrian monarchs reigned over a number of petty kings, the native rulers of the several countries, over the whole extent of their dominions. These native princes were feudatories of the Great Monarch, holding their crowns from him by the double tenure of homage and tribute. This system naturally led to the frequent outbreak of troubles. See CUNEIFORM WRITING; NINEVEH; NIPPUR.

Bibliography.—Botta and Flandin, 'Monuments de Ninivé' (1847–50); Layard, 'Nineveh and its Remains' (1849); Oppert, 'Histoire des Empires de Chaldée et d'Assyrie' (1866); Rawlinson, 'Five Great Monarchies of the Ancient World' (second edition, 1871); Lenormant, 'Lettres Assyriologiques' (1871–3); George Smith, 'Assyrian Discoveries'; 'Assyria,' and 'The Assyrian Eponym' (1875); Duncker's 'History of Antiquity' (1882); Sayce, 'Ancient Empires of the East' (1884); his 'Assyria: its Princes, Priests, and People' (1885), and his 'Fresh Light from the Ancient Monuments' (1886); Jastrow, 'Religion of Babylonia and Assyria' (1898); Maspero, 'The Dawn of Civilization' (1894).

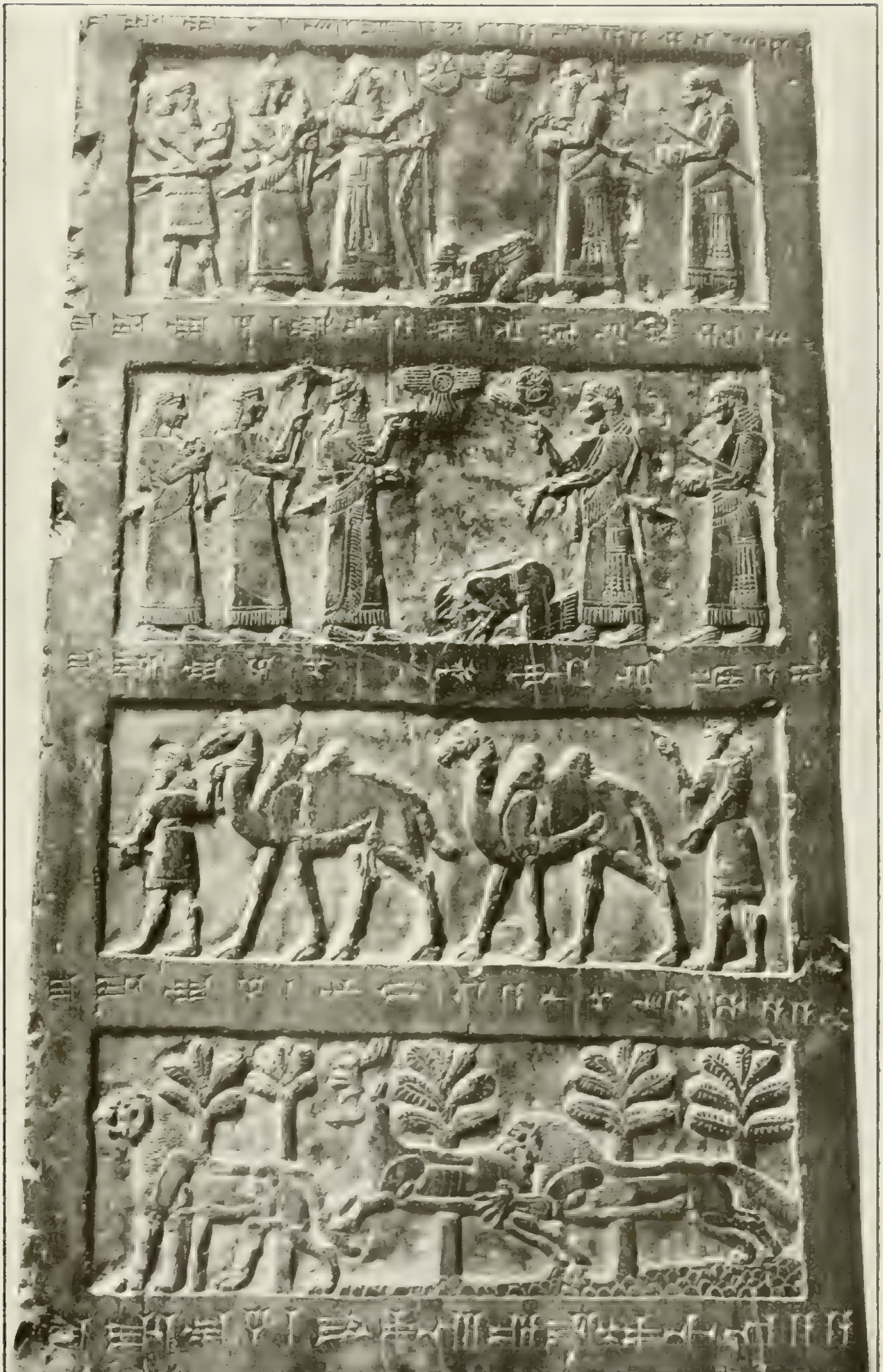
Assyriology. Assyriology may be defined as that department of study and investigation which embraces within its realm the country, people, languages, literature, and history of ancient Mesopotamia, Babylonia, and so much of adjoining countries as shared in the life of the Semitic valley-peoples prior to 538 B.C. The term is often popularly employed to cover a study of those languages written in the cuneiform script, or its immediate antecedents, the linear and picture methods of writing, current in primæval times in this great river valley. Such a delimitation of our theme would include a study of early Babylonia, Assyria, somewhat of Elam, and a mention of later Persia. Assyriology, therefore, deals with an antiquity which was centred in the great Babylonian valley, and embodied in the cuneiform languages.

Age.—This is a comparatively new department of research. It has been built up upon the basis of the discoveries of antiquities which have been made during the last three quarters of a century in the countries tributary to the Persian Gulf. The tentacles of this department reach out into every phase of ancient Oriental life and knowledge, and require of the modern investigator a comparatively comprehensive understanding of the complexities of that primitive life. This department includes in its sphere some of the most important of all branches of ancient lore. Among these we note especially Semitic philology, general archæology, architecture, sculpture, history, legend, so-called science, and religion. Assyriology has already taken its place as one of the great departments of human knowledge and research. The results of its investigations must now be reckoned with in any estimate of early Semitic legends, traditions, or history. Its importance to the student of the Old Testament is assuming greater proportions with each old site overturned by the spade of the excavator. The great museums of Europe and America count among their chief treasures the magnificent colossi, bas-reliefs, slabs, statues, and tablets that belong to the department of Assyriology.

Names.—The oldest of the governments represented in Assyriology is that centred in the Babylonian valley. Its earliest known mention at the beginning of the last century was that found in Genesis x. 10, where the beginning of the kingdom of Nimrod is said to have been Babel (Hebrew, בבל), probably the city of Babylon, "in the land of Shinar" (Hebrew שנער), a name for lower Babylonia. In post-exilic times the country was designated Chaldea, or "land of the Chaldeans" (Hebrew, ארץ כשדים), Ezek i. 3. Classical writers named this country after Babylon, that metropolitan city of their day, Babylonia, and this name is attached to it to the present time.

The next great country covered by Assyriology is Assyria. The Hebrews called it (Gen. x. 11) A'sshur (אשור), either the name of a personage or of a country, probably the latter. The translators of the Septuagint called it ασσουρ and ασσυριος, while Josephus, a couple of centuries later, refers to it as Ασσυρία. The Aramæans named it *Athur*, or *Athuriya*.

Boundaries.—The territory covered by ancient Babylonia was delimited on the west by the Arabian Desert, on the south by the Persian Gulf and Arabian Desert, on the east by Elamite territory backed up by the Zagros Mountains, and on the north by the uplands of Assyria. Assyria proper, in its early unexpansive period, was delimited on the east by the mountains of



RELIEFS ON THE BLACK OBELISK OF SHALMANESER II. (860-825 B. C.)

(FOUND BY LAYARD AT NIMROUD, NOW IN THE BRITISH MUSEUM)

SECOND TIER REPRESENTS JEHU, KING OF ISRAEL, RENDERING SUBMISSION TO SHALMANESER II. (ABOUT 842 B. C.)

EXCAVATIONS BY THE FRENCH AT TELLOH (*after de [illegible]*)

THE FOUNDATIONS OF THE PALACE OF KING UR-NINA

(*Above*) THE SOUTH ANGLE; (*Below*) THE SOUTHEAST FACADE

Kurdistan, on the north by those of Armenia, on the south by Babylonia, with an ever-shifting boundary line, and on the west by the western limits of the Tigris valley and plain. In a word, Assyria was anciently seated in the upper Tigris valley, in possession of several great city-centres.

These two important countries were thus largely guarded by nature from foes on the south and southwest, but were always open to the intrigues of invaders from the east, north, or northwest. The historical records of these lands confirm this statement.

Description.—The great valley of Babylonia derives its marvelous fertility from its two notable rivers, the Tigris and Euphrates. Both have their rise in the mountains of Armenia, and both have their debouchement in the Persian Gulf. The Tigris, from its source, flows directly in a southeasterly and southerly course, cutting through the uplands of Assyria, and along the eastern side of the Babylonian valley, until, mingling with the waters of the Euphrates, it falls into the Gulf. The Euphrates, from its source, flows toward the southwest and bends southward within 100 miles of the Mediterranean Sea, and thence in general toward the southeast and south until, in union with the Tigris, it pours into the Gulf. These two arterial streams are the life of this great lower valley. By irrigation they were made to fertilize all their adjacent lands, and thus placed these among the richest countries on earth. In addition to water these streams bring annually from the mountains of Armenia great quantities of alluvia and deposit it in the lower valley. Geologists estimate that the shores of the Persian Gulf have been pushed southward, by deposits of this alluvia, fully 125 miles since the earliest periods of Babylonian history. In other words, the Tigris and Euphrates rivers that now enter the Gulf as one stream forming a vast morass, formerly had separate mouths, about 125 miles north of their present outlet. If this estimation be correct, the ancient Ur of the Chaldees (modern *Mugheir*) was practically a seaport city. The Tigris, being the shorter river, has a very swift current, and is less valuable for navigation than the Euphrates. Upon this latter stream vessels of profitable draft may ride to a distance of 800 miles above its mouth. The territory of Mesopotamia proper is watered by the Balikh and Khabur, two rivers that flow southward, emptying into the Euphrates. The region of Babylonia proper, though a waste to-day, shows marks of having supported a dense population in antiquity.

References to Ancient Peoples.—Present day students and scholars inferred from frequent references in the Old Testament and in the compiled works of Berosus, Manetho, Josephus, and others that this valley had been the headquarters of mighty nations. Classical writers carry echoes of an ancient glory won by great armies and powerful monarchs from the East, whose records were otherwise unknown, and whose mighty deeds seemed as unreal as fiction. The rise, conquest, and reign of these giant figures aroused the enthusiasm of every student of ancient history. The far-reaching influence and power over neighboring kings of these monarchs, dimly outlined in the vague second-hand records, set scholars to work. It drove them to search far and wide for other traces of peoples who had completely perished from the face of the earth, and who had, so far as they could see, left no story of their achievements. The reports of travelers who had passed through and spent some time in those countries attracted their attention.

Ancient Remains.—The entire territory drained by the two great rivers, Tigris and Euphrates, was found to be dotted by extensive mounds, ruins of ancient walls, piles of disintegrating towers, beds of ancient irrigating canals, and other marks of a once elaborate civilization. Travelers had often picked up near these mounds little bits of antiquities, bricks, tablets, and cylinder seals, that carried on their surfaces many curious wedge-shaped characters, which they regarded either as writing or ornamentation. These miscellaneous curios were thought to represent the civilizations of an unknown past, of peoples who occupied this territory in the days when prosperous cities and fruitful fields filled this great valley.

Earliest Excavations.—The first persons to take an active interest in the ruins of Babylonia and Assyria were Englishmen resident in some one of the chief cities of the country. C. J. Rich, a resident at Bagdad (1808–21), carefully examined and described several mounds, and some inscriptions, in small works published during his residence. The first systematic excavations within this valley were undertaken by P. E. Botta, French consul at the time in Mosul, a modern city of some commercial and political importance on the upper Tigris River, in 1842–5. He began work on the colossal mounds opposite Mosul on the east bank of the Tigris River; but he had little success until he transferred his force to the mound Khorsabad, about 14 miles north-northeast of the first site. Khorsabad proved to be an immense treasure-house of antiquities. Here he uncovered the stupendous royal palace of Sargon II. (722–705 B.C.), with a mass of inscriptions and antiquities of various kinds. This splendid find was greeted with enthusiasm by the scholarly world, and set minds to thinking and wills to acting to uncover other antiquities representing such a marvelous past. In 1845–7, A. H. Layard, an Englishman, began to dig at Nimroud, the ancient Calah, a mound about 20 miles south of Mosul, on the east bank of the Tigris. Persevering through almost indescribable difficulties, Layard finally succeeded in bringing to light the palaces of Assurnatsirpal (884–860 B.C.), Shalmaneser II. (860–825 B.C.), and Esarhaddon (681–668 B.C.). In 1849–51 this same intrepid excavator burrowed into the mound Kouyunjik, one of the mounds of ancient Nineveh, and lay bare two more great palaces, that of Sennacherib (705–681 B.C.), and that of Assurbanipal (668–626 B.C.). Botta's finds, so far as transportable, were taken to Paris and deposited in the Museum of the Louvre; those of Layard to the British Museum in London.

In this same period, Rassam, trained under Layard, made some valuable discoveries (1851–4) at Kouyunjik for the English; and Place at Khorsabad and Fresnel and Oppert at Hillah for the French. In most of the work undertaken by the English, Henry C. Rawlinson was a close adviser and an enthusiastic promoter.

Later Excavations.—The next 20 years (1854–73) were a period of cessation of excavations of any note. An occasional traveler or explorer found a few specimens of antiquities and

did a little desultory work. This 20 years, however, saw the publication of many notable works by Botta, Layard, Place, Oppert, and Rawlinson on the results of the active work of excavating and of inscriptions previously gathered out of the mounds. The second period of excavations began in 1873, when George Smith, of the British Museum, was sent by the London *Daily Telegraph* to the site of ancient Nineveh to find other fragments of the famous deluge tablet. Smith's phenomenal success in finding Assurbanipal's 30,000-tablet-library gave new life to archæological research, and sent him altogether on three expeditions, on the last of which he succumbed to a fever at Aleppo, 19 Aug. 1875. Smith's genius had presented to the world such representations of the important discoveries made by himself and others that the contagion spread, and other centres of scholarship turned their eyes toward the mounds of Babylonia and Assyria. Rassam was again called into requisition, and in 1877–8 gathered rich spoils on the site of old Nineveh, at Nimroud, and at Balawat, where he found the remains of the bronze doors of Shalmaneser II. (860–825 B.C.). In 1878–9 and 1880–1 he also found valuable relics on Babylonian ground.

From 1878 to the present day the French government has conducted excavations intermittently at Telloh, in lower Babylonia, for more than 20 years under the superintendence of E. de Sarzec, and recently under Capt. Crosman. This mound has yielded a rich store of antiquities, consisting of many thousands of tablets, of several beautiful diorite statues, of friezes, of palace plans, and of cylinders, many of which are deposited and mounted in the superb collection in the Louvre in Paris. The accompanying illustration presents two views of a part of the mound Telloh, where such notable discoveries have been made. The same government inaugurated and carried on excavations at Susa under M. and Mme. Dieulafoy (1884–6); and latterly under M. J. de Morgan, and has thus opened up new volumes on the history of ancient Elam, and its relations with adjoining countries.

A few broad-minded gentlemen, under the leadership of E. W. Clark, of Philadelphia, provided the means for the organization and prosecution of an expedition to Babylonia under the auspices of the University of Pennsylvania. This expedition was duly organized and equipped, and prosecuted work under the direction of John P. Peters, during 1888–90 at the mound Niffer, about 30 miles southeast of Babylon. Since that time the same institution has carried on work intermittently on this site, under supervision of H. V. Hilprecht, and, for the most part, under the field directorship of J. H. Haynes, has brought to light thousands of inscriptions and other antiquities. These have made the University of Pennsylvania the richest Babylonian-Assyrian museum in America.

Within the last decade German archæologists have joined the ranks of excavators, and have done some thorough work on several sites in the Babylonian valley, but chiefly at Babylon. The full results of their activity are still unknown to the public, as little has been published.

In 1904, the Oriental Exploration Fund of the University of Chicago was organized, and an expedition sent out under the direction of Robert Francis Harper, to excavate on the old site Bismya, in lower Babylonia. The first season's work justifies the hope that this may prove to be a fruitful mound, belonging to a high antiquity.

Outside of Babylonia proper, some notable discoveries of cuneiform inscriptions have been made by explorers. A stèle of Sargon II. was found in the island of Cyprus in 1845. There were found at Tel-el-Amarna, in Egypt, in 1887, more than 300 cuneiform tablets, which proved to be correspondence between the kings of Egypt and their Asiatic underlords and rulers in the 15th century B.C. Even Palestine has produced a couple of tablets in its excavated cities. Luschan found at Zinjirli, Asia Minor, among a host of Hittite antiquities, a statue and inscription of Esarhaddon (681–668 B.C.).

Decipherment of Inscriptions.—The neat little wedge-shaped characters, put together in so many combinations to form individual signs, very early attracted the genius of the linguist. As early as 1801, Grotefend, a German, discovered the significance of some of the old Persian cuneiform characters; and other scholars, following in his wake, likewise made some advance in identification of those old characters. But the long and sure step ahead was not made until Henry C. Rawlinson took up the problem. As an officer in the Persian army about 1835, he had unusual facilities for examining ancient ruins in that country. He observed at Behistun, in the Zagros Mountains, a rock stretching up almost 1,700 feet above the plain, and at about 350 feet above its base a large space carefully smoothed off. Upon this space was inscribed a mass of writing, distributed in several columns of varying length. After years of toil at intervals, he succeeded in copying the entire set. In a study of them he soon found that they contained three languages. The first, the Old Persian, through his knowledge of modern Persian and other related tongues, after years of study, he was able to decipher, and sent his translation to London, where, in 1847, it was published in the 'Journal of the Royal Asiatic Society.' Rawlinson's success was epochal, for it broke the seal into the hidden treasures of the cuneiform languages of Babylonia. His decipherment of one of the trilingual inscriptions opened the door into the next, the Susian. These two deciphered, scholars were soon able to penetrate the mysteries of the third language, the Babylonian-Assyrian.

These triumphs extended, roughly, over the years 1845–55. In 1857 the British Museum made a test of scholars' ability to decipher the Assyrian tongue. Four men, H. C. Rawlinson, Edward Hincks, Jules Oppert, and H. F. Talbot, were given a fine copy of a long historical inscription of Tiglathpileser I. (1120–1100 B.C.), and were requested to make each an independent translation of the text and report on their results. At a given time these scholars reported; and to the amazement, one should say, of all concerned, their translations were in substantial agreement from first to last. This was the crowning triumph of all in the eyes of other departments of learning. It showed that the riddle had been solved, that the Babylonian valley would henceforth speak for itself through its multitudes of ancient records.

Furthermore, this triumph of philology suc-

ceeded in placing in the galaxy of ancient nations some of the most powerful of peoples. Babylonia, Assyria, and Elam henceforth became the early home of vigorous nations, well-organized governments, conquering armies, and world-wide rulers. The ruin-covered wastes were suddenly transformed into fertile fields and prosperous cities, occupied by peoples whose influence touched the horizon of civilization in every direction. In short, this triumph of philology opened a door to a new world in southwestern Asia, prior to, and contemporaneous with, the times of the Hebrew kingdom.

Language.—The language in which this new-old material is preserved is the so-called Babylonian-Assyrian wedge-writing. Although the Old Persian is alphabetic, the Babylonian-Assyrian is a sign and syllable tongue. Each separate wedge ( ), or each combination of wedges ( ), constitutes a sign. This language was written by pressing the wedges with an instrument into clay or cutting them into stone or metal, for they never appear in relief. The primitive signs were probably rude pictures, which gradually grew through use into the form of curved and straight lines; these lines soon took on the artistic form of wedges. This evolution is seen in the fact that a large number of the signs possess merely an ideographic value; for example, we find a sign for the idea "land" ( ), "sun" ( ), "male" ( ), "female" ( ), "make," "fish," "king," etc. Some of these signs possess a syllabic value, as *da, ra, la, mat, lak, rid, zun, pad,* etc. Quite a number possess several syllabic values, the context being the reader's only guide as to which should be used in any given case. The reader's troubles are still more aggravated by the fact that the same sign sometimes has both ideographic and syllabic values. In this, as in the preceding case, the reader's tact must find in the context the reason for the reading which he should adopt.

There are about 600 independent and entirely distinct signs formed by combinations of anywhere from 2 to 30 wedges set together at different angles, or paralleled, or inserted within other combinations. But the great difficulties arise when we find that there were almost numberless combinations of anywhere from two to six different ideographic signs to express other and often compound ideas. There are nearly 20,000 such combinations known to-day to Assyriologists.

This Babylonian-Assyrian language is Semitic in character, though its soil is thought, by a large group of English, German, and French scholars, to be a non-Semitic tongue, the so-called Accadian or Sumerian. This question is prominently in the foreground to-day, due to the large accession of new material gathered at Telloh and Nippur, written in this ideographic tongue. The Babylonian-Assyrian tongue is a half-sister to the Hebrew of the Old Testament, and has already proved its real value in the interpretation of that book.

The People.—The peoples best known to Assyriology are Semites. The primitive inhabitants of Babylonia, the predecessors of the Semitic population of Babylonia and Assyria, were probably a mixture of various nationalities, with Semites in the lead. The group of scholars referred to in the preceding paragraph maintain that the predecessors of the Semites were Sumerians or Accadians, the inventors of the ideographic cuneiform language of those countries. We know, at least, from inscriptions found at Nippur, that the Semitic language was in use in Babylonia as early as the fourth millennium B.C. The population of Babylonia and Assyria in historic times was Semitic. Their location made them warriors, for they had to be perpetually on the defense. The Babylonians cultivated the peaceful arts and were wide awake to the best things of life in their time and day. The Assyrians, on the other hand, built up an engine of warfare, a tremendous military machine, that, under powerful leaders, beat down and overthrew nations on every hand. Some one has compared Babylonia and Assyria to Greece and Rome respectively, as fostering and furthering different elements of national life and character.

The Civilization.—One of the marvels of these ancient peoples was their advancement in all that counts for civilization. Their governments were monarchical and well organized, with standing armies for their immediate protection. Their civil courts were provided with ample laws for the regulation of society and of trade. Their cities were advantageously built, and surrounded with walls of a magnitude sufficient to withstand any ordinary attack. Their schools were carefully fostered and occupied a first place in their peaceful life. They cultivated the arts with assiduity and attained a notable degree of perfection in some lines. Their architecture and sculpture, their language and literature, are marks of a people high in the scale of Oriental civilization. Of religious ritual and all its accompaniments and organization, we have a detailed description, which exhibits this as a favorite side of that early Semitic life. Their industry and trade activities were such as to place them in the front rank of commercial peoples. Their amusements and sports were of that adventurous and daring kind that bespeak the virility and strength of character found only among a hardy and vigorous people. Their political and commercial relations with their neighbors were such as mark an advanced stage in cordial international affairs. Their methods of warfare, and their treatment of their subjects, while often cruel and inhuman, were distinguished by a high grade of intelligence, and more than ordinary genius.

Natural Resources.—The wasteness and barrenness of modern Babylonia give little intimation of its early resources. Its flora was quite varied and useful. Its plains were plentifully supplied with fruit trees of various kinds, such as fig-, olive-, date-palm-, vine-, and various nut-trees. On the mountain sides were found the oak, plane, and pine trees of different varieties. By cultivation the land produced wheat, barley, sesame, millet, hemp, and other cereals and articles of commerce. The date-palm was their universal utility article, for from it they seem to have manufactured honey, flour, vinegar, wine, and raw material for wickerwork. The reed that grew with such luxuriance on the banks of the rivers and canals was utilized for a number of purposes. It served for building huts, weaving mats, and for boat-building, and

for layering mortar in the construction of walls.

The absence of stone and minerals in the basin of the valley was partially compensated for by their proximity to the mountains on the north and east, though clay bricks, sun-dried and burnt, were always their chief building material. When marble, alabaster, diorite, or any of the precious metals were used they were brought either from their mountain borders or from distant lands. Stone was used for colossi, statues, wall decorations, bas-reliefs, and some inscriptions. The precious metals were employed for making jewelry, ornaments, serviceable utensils, decorations on buildings and gates, and for tablets upon which inscriptions were engraved.

The list of the fauna of the country is made quite complete by the pictures found on the walls of the old palaces and temples, and by the catalogues of names preserved in their literature. These reveal to us a great variety of valuable animals. Among them we find the lion, the favorite game hunted by kings, the panther, the wild ox, the fox, the wild boar, wild asses, and camels — especially in later periods of history. There were also several kinds of gazelles and antelopes that played about on the border hills and mountains. Of domestic animals, there were the horse in later times, the ass, the camel, the cow, sheep, goat, and dog. Of wild birds, the inscriptions mention most frequently the eagle and the owl; also the swallow, dove, raven, geese, and other waterfowls.

Cities.—There is no more notable index of a great people than the number and magnitude of its great cities. Babylonia-Assyria, through the decipherment of the monuments, is seen to have been well dotted over with prosperous cities. Beginning in the south and proceeding northward, we find in that ancient day, Eridu, Ur, Erech, Larsa, Lagash, Nisin, Nippur, Borsippa, Babylon, Cutha, Sippar, and Agade (!)— all famous cities in the Babylonian kingdoms and empires of four millenniums ago. The earliest civilization of that valley was centred in these cities, most of which seem to have been originally capitals of districts. There are other mounds in considerable quantity that have not been identified, but which doubtless cover still other cities that played an important role in the life of early Babylonia.

As we advance into the territory occupied by Assyria great cities present themselves in a formidable array. The ancient mother city of Assyria was Ashur, located on the right bank of the Tigris, near the modern *Kalât Sherkât*, now being excavated by a German expedition. As we pass up the Tigris River of that day the next city of importance that one meets is Calah, or Nimroud, on the left bank of the river, just above the junction with the Tigris of the Upper Zab River. This was a palatial city, first unearthed by Layard, and then by Rassam, containing at least three royal palaces already mentioned. Off to the east of Calah, on the east bank of the Upper Zab, was Arbela, a minor city of importance. Nineveh, whose mounds stand on the eastern bank of the Tigris opposite the modern Mosul, was a very ancient city. The small stream or river *Khosr*, passing between the two great mounds Kouyunjik and Nebi Yunus, that represent the remains of Nineveh, empties into the Tigris. Sargon II. (722–705 B.C.) built for himself at Khorsabad, north of Nineveh, a veritable royal city, the most magnificent building of which was his palace, uncovered by Botta and Place. Its name, Dur-Sargina, "the wall or fortress of Sargon," designates sufficiently its significance for his reign. To the southeast of Nineveh we find another city of especial significance in the reign of Shalmaneser II. (860–825 B.C.), Imgur-Bel, on the site of the modern *Balawat*.

Adjacent to this valley were such mighty cities and fortresses as Susa in Elam, Harran and Reshini in upper Mesopotamia, and Carchemish, with other cities on its western frontier — all evidence of the thrift and permanency of the civilization of 3,000 and 4,000 years ago.

Architecture.—The buildings of Babylonia-Assyria were modified architecturally, no doubt, by the character of the material accessible for their construction. Throughout this entire valley the absence of stone led to the use of clay bricks, sun- and kiln-dried, for building material. This, of course, necessitated a plainness of form that admitted of little exterior decoration. The walls were often built very thick, of sun-dried, with a veneer of kiln-dried, bricks. This veneer was a protection against the ravages of the weather, and the depredations of robbers, who could readily dig through a thick wall of merely sun-dried bricks. The strength of a sun-dried brick wall was sometimes increased by inserting between the courses of bricks layers of reeds. The entire structure was built on an artificially raised mound, primarily to lift the building above the danger of the overflowings of the rivers, but later apparently because of the age-long custom of placing it on an eminence. The entrances to the palaces and temples were usually guarded by great monolithic colossi, human-headed bulls or lions, standing on each side and facing outward. Within were courts of different sizes that served the royal personages or their attendants. In immediate connection with each palace or group of royal buildings, particularly in Babylonia, was the tower or temple. It was a structure that towered above everything else, and rose from its base to its summit in a series of stages, sometimes seven, or steps, by which one ascended. On the top of this massive pile one would find the image of the god held in particular reverence, or to whom the tower was dedicated. There are several remains of these sacred structures found in Babylonia to-day. Their ability to withstand the ravages of time is due to the hard burnt bricks with which they were constructed. The remains of the tower at Mugheir, the ancient "Ur of the Chaldees," was built, according to its present indication, upon a platform 20 feet above the plain; its base was a parallelogram about 200 feet by 135 feet.

One of the niceties of these constructions was their adaptation to the necessities and comforts of the people. There was an admirable system of drainage, of hydraulics in general, that embodied some of the best principles of modern sanitation. The arch contributed no little to the construction of some of the primitive royal buildings of the 20th century B.C.

Sculpture, Engraving, etc.—The most precious contents of the temples and palaces were the statues of the gods and kings, respectively.

BLACK DIORITE STATUE OF GUDEA FROM TELLOH *(after de Sarzec)*

(ABOUT 2800 B.C.)

(NOW IN THE LOUVRE, PARIS)

They are the best specimens of the sculpture of the Babylonian-Assyrian peoples. These works of art were often chiseled out of diorite, as those found by the French at Telloh, out of alabaster, as many of the giant colossi, or out of a basaltic rock, or black marble. The sculptors, even as far back as 3000 B.C., executed some wonderful work. Even more striking and complicated were their bas-reliefs, found so numerously on the walls of the palaces of the Assyrian kings. In this species of art there is often superb genius displayed in the introduction of many figures, of warriors, war-chariots, cavalry charges, battle scenes, sieges and captures of cities, and divinities of various grades. But in all these representations the modern student must not be disconcerted because of the lack of perspective. This is one of the characteristics of all early relief work and painting, and must be reckoned with in our study of those times.

Besides the large and imposing works of art, there were numerous small objects that occupied large attention and revealed some real artistic skill. There were the silver vases of the time of Entimena (about 3800 B.C.), ivory objects showing exquisite workmanship, gold ornaments, cylinder seals reaching back to 4000 B.C., of many precious stones whose intaglio work would be a credit to this day. The method of executing such fine work on the hardest of precious stones is still a puzzle to modern engravers. The decorations of Assyrian and Persian palaces include also painting, though of a kind that reveals more crudeness than the specimens of the engraver's art.

Literature.—The discoveries of the last three quarters of a century have opened for us the doors to a new library of ancient Oriental literature. These clay and alabaster volumes cover a large range of subjects, and treat them in a manner entirely unique. The first that attracted attention was, of course, the immense amount of historical matter, found mainly in the ruins of Assyria. Another large element in these tablets, particularly in Babylonia, is the poetry, pure Semitic poetry, or interlineated with so-called Sumerian poetry, whose character is determined by the presence of parallel members. This poetry contains hymns to the gods, penitential psalms, incantations, magical formulæ, and even epics of surprising strength. Examples of this poetry in Assyria were copied from Babylonian originals, as Assyria was notably weak in its literary ability. Then there are legends, mythology, and popular treatments of technical subjects. We find also treatises that are geographical, biological, geological; tablets that are commercial in character, recording loans, deeds, rents, and trades; long lists of matter that is purely linguistic, for it deals with signs and their values; a codified system of laws that touched almost every complication in the complexities of Babylonian life; letters, domestic and international, that reveal both the home customs of the nation and their foreign relationships and authority.

Myth and Legend.—The poems that are sometimes called epic, in the literature of Babylonia, are based upon events that are usually termed mythical. The epic and mythical elements are so thoroughly commingled that the entire narrative may be termed mythological. The scenes depicted are those between gods and gods, and between gods and men, and other creatures. The most famous stories classified as mythology are the so-called creation epic, the epic of Gilgamesh, of which the eleventh tablet or poem is the Babylonian story of the deluge. There are several legends and fragments of legends which have received careful study in recent years, whose matter is arranged on the customary Babylonian poetical plan. Some of these are, the descent of Ishtar into the world of departed spirits, the Namtar legend, the Adapa and Etana legends, and legends of various gods. Some of these entertaining literary stories take their place for real merit and interest beside the best legendary lore of ancient Greece. Their archæological value is often considerable, and their relation to the religious life of Babylonia-Assyria immeasurable.

Religion.—The primitive religion of Babylonia was doubtless the worship of the different powers of nature. These became personified and everything that took place in the world was simply the result of the action of some particular god, who stood above man in the scale of being, and executed all movements in the especial sphere where he was supreme. The representatives of these divinities on the monuments are seen sometimes to be men, and at other times to be part man and part beast and bird. Those in the form of men possessed attributes like, but far superior to, man. Since they represented different powers in nature, none of them was all-powerful. Their functions lay in special lines, and for these they were worshipped. In Assyria, the gods as a whole were practically borrowed from Babylonia. But Asshur, the great divinity of Assyria, stood alone, unique in all the Mesopotamian pantheon, and supreme in Assyria. The chief gods of Babylonia, those that were supreme in its pantheon, were three, Anu, the god of heaven, Bēl, the god of the earth, and Ea, the god of the abyss and of secret knowledge. These great three were followed by another triad, who regulated light and the weather, namely, Shamash, the sun-god, Sin, the moon-god, and Ramman, the weather-god. These six divinities were localized, in that each was the patron deity of some city. For example, Anu was the patron deity of Erech, Bēl of Nippur, Ea of Eridu, Shamash of Larsa and Sippar, and Sin of Ur (of the Chaldees). There is a long list of other gods and goddesses, who were doubtless related to the two chief triads, but up to the present time this relationship in all cases cannot be determined. Slightly aside from the lists already named we find the great goddess Ishtar, one of whose feats is described in the legend, 'Descent of Ishtar.'

Worship.—The cities of Babylonia-Assyria were well supplied with temples, in which the gods were devotedly and assiduously worshipped. Indeed, this worship was an essential element in the life of the Babylonians, to a greater extent than among the Assyrians. The temples were the most elaborate buildings of Babylonia, and were under the immediate direction of the priesthood, the most powerful class of men, next to the king, in the nation. Babylonian inscriptions, particularly, enumerate many temples in the chief cities that were dedicated to the patron deity of each several city. Each temple had an organization of official priests, whose duties

were the preservation and propagation of the worship of the god of that temple, and the ritual and traditions thereof. The king was the great overlord or guardian of the temple, and spared no means to keep it in a thoroughly good state of preservation, and to increase its popularity among his subjects. The support of the priesthood was provided for by revenues produced by the lands attached to the temple, or belonging thereto, supplemented by regular offerings. These priests, as those in Egypt, were the most influential men in the kingdom, for they controlled the religious life of the community, and had no small part in the affairs of political and civil life. They were probably the best educated men in the nation, and by their learning filled the offices that required a somewhat broad training, such as scribes, historians, and librarians.

The regular duties of the priests in connection with the temple service were (1) to officiate at all the regularly appointed services of the temple, including the monthly and annual set feasts, and (2) to carry out the worshipful desires of any individual worshipper. The minutiæ of conditions regnant in temple service are voluminous, and touch almost every condition of life. Some of the incantations and psalms, already referred to, preserve the petitions that must be recited by the suppliant. Other tablets enumerate the great variety of offerings that must be presented to the gods to secure their good-will and blessings. The multiplicity of such requirements easily kept an army of priests busy in the great temples of the principal cities of Babylonia-Assyria.

Sources of Babylonian-Assyrian History.—Before the excavations of the last 75 years in the ruins of Babylonia-Assyria, the two main sources of the history of the peoples and country in our theme were (1) the books of the Old Testament, and (2) the second-hand narratives of Berosus, Manetho, and Josephus, with a few scattered statements and some questionable narrative in Greek and Roman writers. The discoveries in the ruins of Mesopotamia have now given us first-hand information of the best kind, narratives just as they were written down by the original scribes, and not copies made from age to age, as are the works above referred to. These clay, stone, and metal records stretch not continuously as yet, but with breaks here and there, from at least 4000 B.C. down through the fall of Babylon before the army of Cyrus 538 B.C. Of course, they cannot be regarded as infallible, but are still for our purpose reasonably reliable. They give us, at least, a new panorama, of the most vivid kind, of the great nations that moved down the avenue of time in Babylonia for nearly 4,000 years.

Chronology.—The chronology of Babylonia must be described in part separately from that of Assyria. The early Babylonians reckoned events from some great calamity or occurrence, such as the destruction of a city, the dedication of a temple, or the opening of a new irrigating canal. Later down in the history they counted time by the years of a reigning king. The "List of Kings," a list of the kings (not complete) of Babylon from about 2400 B.C. to 625 B.C., by dynasties, with the length of reign of each king and of each dynasty, and the so-called "Babylonian Chronicle," consisting of a record of events in Babylonia and Assyria from about 745 B.C., early in the reign of Nabonassar, to 669 B.C., the beginning year of the reign of Shamash-shum-ukin are valuable documents. The Ptolemaic Canon, which has some reliable features, also begins with Nabonassar's reign. Besides these guides there are references here and there that both serve as checks and give us fixed points from which and toward which we may figure. One of the most striking is that mentioned by Nabonidus (555–538 B.C.) on one of his cylinder inscriptions. He there states that an inscription of Sargon which he found in the corner-stone of a temple had been deposited in its hiding place 3,200 years before his day, or about 3750 B.C. The more we find of ancient Babylonian facts the more probable the correctness of this date seems to be. Then there are chronological notes and hints, such as the statement that Burna-buriash lived 700 years after Hammurabi, that Marduk-nadin-akhe defeated Tiglathpileser I. 418 years before Sennacherib conquered Babylon. Each such hint furnishes a valuable check on the whole chronological scheme, and aids the scholar in his construction of a valid and reliable list of rulers and events, even though for the present there are some wide and embarrassing gaps in the period covered by Babylonian history.

Assyrian chronology follows a unique plan. It names the years after certain officers, termed eponyms, whose term of office extended over but one year. Lists of these eponyms have been found stretching from 893 B.C., during the reign of Adad-nirari II. (911–890 B.C.) down to Assurbanipal (668–626 B.C.). On some of these lists we find merely the name of the eponym, on others there is found the name of the king in authority, in fact he usually was an eponym at some time during his reign, and some of the chief events of each year. The succession of events between the limit years mentioned above is now positively known. To verify our calculation that these Assyrian records are correctly poised in time, we find that in the month of Sivan, year of eponymy of Pur-Shagalti, there was a total eclipse of the sun in Nineveh. Astronomers have located this same eclipse on 15 June 763 B.C., thus giving us a fixed point for our calculations, and for settling specifically the dates of the entire Assyrian eponym lists.

Historical Periods — Babylonia.—The history of Babylonia may be roughly divided into three periods: (1) That stretch of time reaching from the remotest recorded events down to the time of the consolidation of the kingdoms of Babylonia under Hammurabi at Babylon, about 2250 B.C.; (2) the time included between Hammurabi's supremacy and 626 B.C., the death of Assurbanipal, last great king of Assyria, and the rise of Nabopolassar, first king of the new Babylonian kingdom; (3) beginning of Nabopolassar's reign (625 B.C.) to the fall of Babylon before Cyrus (538 B.C.).

First Period — Babylonia.—The beginnings of this period are enveloped in fog. Scattered fragments of antiquities and archaic inscriptions tell a broken tale of a very remote antiquity. Telloh, Nippur, Babylon, and Susa have yielded to the excavator many evidences of an extreme antiquity, and have put into our hands material for beginning to estimate some of the elements of such early civilizations. Some of the earliest

kings were those who ruled over Erech and Lagash, which occupied territory apparently on the north and south side, respectively, of the irrigating canal, *Shatt-el-Hai*, connecting the Tigris and Euphrates rivers. Other kingdoms in this early period, apparently earlier than 4000 B.C., were Kish and Ur. The formal name of a governor in this earliest age was *patesi*. Lugal-zag-gi-si, however, king of Erech, apparently a Semitic name, designates himself "king of Erech, king of the world," but calls his father Ukush, "*patesi* of Gishban." Other kings of this very early period were Ur-Ninâ, the foundations of whose palace at Telloh are to be seen in the first illustration, and E-dingirrâna-du. E-dingirrâna-du was a *patesi* of Lagash and a victorious ruler, who seized and maintained authority, among others, over Gishban, Kish, Erech, Ur, and Larsa. These events must have occurred about 4000 B.C.

About 3750 B.C., according to the reckoning of Nabonidus, already mentioned, we find Sargon I. in power, swaying his sceptre to the westward as far as the shores of the Mediterranean Sea. His son, Naram-Sin, carried on the extensions of his father's kingdom until he included in his realm northern Syria, northern Arabia, Mesopotamia, and Elam. He designates himself, therefore, "king of the four quarters of the world." There is a break in the records at this point. The next ruler, rather *patesi*, of Lagash apparently inaugurates a new reign, that enfolds within its borders the sway of all southeastern Babylonia, including also Elam. This *patesi* was Gudea, one of the most famous rulers of this valley, at about 2800 B.C. The accompanying cut represents one of his inscribed statues of block diorite found at Telloh, around which we find 366 lines of writing very artistically cut into this hard stone. On the lap of the statue there is a plan of a building, designed in exact proportions, revealing the measurements current in Gudea's day. His numerous inscriptions tell us of his world-wide commercial activity, though his political power may not have included more than Elam outside of Babylonian territory. The power of the *patesis* of Lagash stretched over some time, and was a distinct force in the civilization of lower Babylonia. We have also the names of several kings of Ur, of Nisin, of Erech, of Larsa, and of some smaller cities, whose exact location in the chain of history is not as yet fixed.

Second Period — Babylonia: First to Third Dynasties. Beginning of Assyria.—The isolated kingdoms of Babylonia had already existed for centuries, with here and there a ruler who had been able to gain the supremacy over one or more of his neighbors for a time. But the man above all others who unified these scattered realms under his own sceptre, with Babylon as a centre, was Hammurabi, whose long reign of 55 years began about 2285 B.C. He greatly improved the internal condition of his own country, both materially and politically, and carried his conquests to Elam, as had Sargon I., his predecessor by 1500 years. Hammurabi's influence and power for the welfare of his subjects have been brought out anew by the discovery at Susa, in December 1901–January 1902, by M. J. de Morgan at the head of the French expedition, of a code of laws which had been compiled under his direction and orders. This remarkable document shows that Hammurabi's government was thoroughly regulated, for it provides laws now intact to the number of 243 to govern the complexities of commercial, social, and official life. Successive kings of this first dynasty, founded about 2400 B.C. by Sumuabi, are known as yet but slightly, though many contract tablets belonging to this period have been found.

The second dynasty in the "List of Kings" consists of 11 rulers, about whom we know nothing. It is thought that during their reign the Kassites made their way into Babylonia from the countries of Media and Elam and secured a hold on the throne.

The third dynasty in the "List of Kings" is made up of 36 kings, but only a few names at the beginning and at the close are preserved. The "Synchronous History," however, supplements this *lacuna* in some respects, and gives us an idea of the relations of this dynasty to Assyria. In fact, early in this dynasty the former little colony of Assyria, which had migrated from Babylon some time about 2500–2300 B.C., rebelled against its mother-country, Babylon, and secured its independence. Its first king of whom we know the name was Bēl-Kapkapu, mentioned by Adad-nirari III. as an early king on the Assyrian throne. Ashur-bēl-nishishu is the first king about whom we know anything of value. He ruled about 1480 B.C. and was on friendly terms with Kara-indash, a king of the third Babylonian dynasty. Several successive Assyrian kings seem to have perpetuated this friendship, but jealousy and hostility sprung up and there were, repeatedly, clashes of arms, in which, on the whole, the young and vigorous Assyrian kingdom was victorious. One of the notable Assyrian kings of this period was Shalmaneser I., who ruled about 1330 B.C. His great campaigns against the territory northwest of Assyria are celebrated in the records of Assurnatsirpal (884–860 B.C.).

Second Period — Babylonia: Fourth to Seventh Dynasties. Assyria, 1120–1075.—The fourth Babylonian dynasty is called the dynasty of Pashe. We are not aware of the name of its founder. The "List of Kings" is, unfortunately, mutilated so that we have only portions of the names of the last three kings. The "Synchronous History" fills part of the gap by giving some of the relations between Babylonia and Assyria during the life of this dynasty. These relations were hostile in some of its earlier years, when Nebuchadrezzar I. was on the throne, and the battle went against the Babylonians. Then Marduk-nadin-akhe, a Babylonian king, wrested victory from the Assyrians. Tiglathpileser I. (1120 B.C.), king of Assyria, on the other hand, completely routed the same Babylonian king, captured a number of cities in North Babylonia, and even Babylon itself. Succeeding kings of this Babylonian dynasty and of Assyria made treaties of peace, and for the time being ceased their wasteful warfare. Of all the Assyrian kings who reigned in the time of this Babylonian dynasty, Tiglathpileser I. was the most vigorous, aggressive, and successful. His example furnished an inspiration for all succeeding Assyrian rulers, and his conquests, related in full in his cylinder inscription, give us a fine specimen of early Assyrian historical writing.

The fifth Babylonian dynasty (about 1050 B.C.) consisted of three kings and was very short. It has been called the "Sea-land" dynasty, because it is thought probable that the Chaldeans about the head of the Persian Gulf were the occupants of the throne. At least, it is probable that the country was in political confusion during the life of this dynasty.

The sixth dynasty (about 1025 B.C.) was that of Bazi, and, like its predecessor, had just three kings, of whose acts very little is known.

A gap of about 100 years is found at this place in our sources, a part of which is attributed to the unknown seventh dynasty — possibly an Elamite, which is said to have ruled six years.

Assyrian history likewise has a gap of more than 100 years (1070–950 B.C.). The "Synchronous History" leaves us in the dark in this period.

Second Period — Babylonia: Eighth Dynasty. Assyria about 930–783 B. C.—The eighth dynasty of Babylon is supposed to have been native Babylonian, and occupied the throne from about 1000 to 800 B.C. The kings who ruled in Babylon during these 200 years fought a losing battle with the Assyrians, for in almost every clash the Assyrian was victorious. Though the names of the early kings of this dynasty are lost, we know those of the kings who waged war with Assyria during the larger portion of the life of the dynasty. With this dynasty the "Synchronous History" closes.

The Assyrian records, the "Eponym Canon," begin in this period, at 893 B.C., and give us a continuous annual list down to 666 B.C. One of the most notable Assyrian kings of this period who have left us their records was Assurnatsirpal (884–860 B.C.). This king was one of the most energetic and aggressive monarchs of Assyria. He established Assyria's authority in every direction, even to the coasts of the far-off Mediterranean Sea. His reign was vigorous, cruel, and even barbaric. Locally, he built a great palace at Calah, and one at Nineveh, and restored the temple of Ishtar at the latter place. His son, Shalmaneser II. (860–825 B.C.), still further extended the limits of his paternal realm by including lakes Van and Urumiyeh, in Armenia, and becoming protector of Babylon. To students of the Old Testament his reign assumes more than ordinary importance, for he was the first Assyrian king to come into contact with the Hebrew nation of Palestine. He mentions "Ahab of Israel" and "Jehu, son of Omri," both of whom became his subjects in the Westland. The accompanying illustration presents four of the five reliefs on one of the four sides of the famous Black Obelisk of Shalmaneser II. These four represent the tribute paid by four foreign countries to the Assyrian king. The inscription over the first relief reads: "Tribute of Sûa of the land of Guzan, silver, gold"; over the second: "Tribute of Jehu, son of Omri, silver"; over the third: "Tribute of the land of Mutsri, double-humped dromedaries"; over the fourth: "Tribute of Merodach-abil-utsur of the land of the Sukhites." These four reliefs and inscriptions are only the first of four, the other three being found on the other three sides of the obelisk. Shalmaneser's son, Shamshi-Adad II. (824–812 B.C.), succeeded him on the throne, and rescued the kingdom from a rebellion which had been stirred up by a brother. His only notable conquest was over Babylon under command of King Marduk-balatsu-ikbi.

The next king of Assyria was Adad-nirari III. (812–783 B.C.), son and successor of his father. His was a prosperous reign, reaching to Tyre, Sidon, Palestine, and Philistia. Even Mari', king of Damascus, yielded submission to his sway.

As in Babylonia, so the next rulers in Assyria, three in number, amounted to little.

Assyrian Supremacy: Tiglathpileser III. Babylonian Subjection.—Assyria's three lethargic rulers between 783 and 745 left no records that deserve mention. But their great successor, Tiglathpileser III. (745–727 B.C.), redeemed the ancient reputation of the empire. This new king, although a usurper, revolutionized the policy and methods of the Assyrian empire. He pushed out the boundaries of Assyria farther than any predecessor on the throne. He completely subdued Syria, Palestine, and Philistia. According to his own records, he, more than any other Assyrian monarch, came into close contact with the Hebrews. He mentions Menahem, Pekah, and Hoshea, kings of the northern kingdom, and Uzziah and Ahaz, kings of the southern kingdom. To him also is to be attributed the policy of deportation of captives from a given district, and importation into that same district of peoples from distant districts, in order thereby to prevent the possibility of uprisings and rebellion. He also inaugurated a kind of local self-government, or provincial districts, as parts of his administrative policy, thus making a decided advance over the reign of his predecessors.

The next Babylonian king of whom we know anything of consequence is Nabonassar (747 B.C.), mentioned in the Canon of Ptolemy, as well as in the "List of Kings" and the "Babylonian Chronicle." But from this time down to the rise of the new Babylonian empire, Babylon was everywhere practically in the hands of Assyria, though there were some sanguinary struggles for the supremacy.

Sargon II. (722–705 B. C.).—Tiglathpileser's successor was Shalmaneser IV. (727–722 B.C.), about whom we know little, as none of his inscriptions have been found. His one act of note was the siege of Samaria in 724 B.C. His successor was Sargon II., whose first act was the capture of Samaria in 722 and the deportation of the Jews to various parts of his empire. This Sargon was a master ruler, who not only subdued and held in subjection the peoples on the east coast of the Mediterranean Sea, but also with indefatigable skill put down Merodach Baladan of Babylon and his attempted conspiracy (cf. Isa. xxxix.). Sargon's great home achievement was the construction of that colossal palace at Khorsabad, just north of Nineveh, that was first discovered by Botta in 1842, as already described.

Sennacherib, 705–681 B. C.—Sargon II. was assassinated in his new palace at Khorsabad in 705 B.C. and was succeeded by Sennacherib, his son. This vigorous ruler conducted at least three successful campaigns: (1) against the Westland: Syria, Phœnicia, and Palestine (701 B.C.), when he overran Judah, carried off 200,150 captives, threatened Jerusalem, making Heze-

kiah his subject, and met and, according to his own records, defeated an Egyptian army at Elteku; (2) in an expedition against Elam (693 B.C.) he was only partially successful, not quite reaching the capital, Susa; (3) in 689, he sacked, burnt, and practically destroyed the city of Babylon, in revenge for the rebellious acts of its former ruler and inhabitants. Sennacherib removed the capital from Calah to Nineveh, and erected for himself a magnificent palace in that newly made capital of the unified Assyrian-Babylonian empire. Other public works of an extensive nature, such as arsenals and water supply, were the objects of his energy. Sennacherib was murdered by one of his sons, according to the "Babylonian Chronicle," and was succeeded by Esarhaddon, his son, who was not engaged in the conspiracy.

Esarhaddon, 681–668 B. C.; Assurbanipal, 668–626 B. C.—Sennacherib's son, Esarhaddon, carried on a successful warfare against the mountaineers to the north and northeast, and was the first Assyrian ruler to carry his conquests into Egypt. In 671 B.C. he crossed the frontier of that age-old land, took Memphis, and carried his arms as far as Thebes, driving the Ethiopian monarch of Egypt, Tirhakah, back into his homeland. He was the first king of Assyria who could add to his title, Egypt, Paturisi (biblical, "Pathros") and Kus (biblical, "Cush," "Ethiopia"). In his list of 22 tribute-paying kings of the Westland, we find "Manasseh of Judah." He was succeeded by his son, Assurbanipal (the "Sardanapalus" of the Greeks, and "Osnappar" of Ezra iv. 10). Egypt had revolted about the time of the death of Esarhaddon, and thus necessitated the early attention of Assurbanipal to hold it. He was completely successful, driving back the rebel Tirhakah, and re-establishing his authority over the whole land. A second expedition was required again in 663 B.C., when the land was completely reconquered and Assyrian authority re-established. Very soon, however, Psamtik of Egypt, with the help of foreign troops, threw off the yoke of Assyria. Assurbanipal's great work was the conquest of Babylon and his rebellious brother Shamash-shum-ukin in 647 B.C.; and, after several terrific battles, the crushing of the power of the Elamites in 640 B.C., by the capture and destruction of their great capital, Susa. These colossal military achievements marked the culmination of Assyria's career, for henceforth there was a rapid decline. Assurbanipal's notable contribution to the history of literature was his causing to be collected and copied for his royal library at Nineveh many of the most famous pieces of literature found in the libraries of Babylon. The last years of his reign are wrapped in obscurity.

Third Period — Babylonia: Rise of Babylon, 625 B. C. Fall of Assyria, 606 B. C.—Almost simultaneously with the death of Assurbanipal (626 B.C.) we find one of his former generals, Nabopolassar, a Chaldean by descent, securing the throne of Babylon for himself (625–605 B.C.). While he was developing and extending his influence and grasp over the territory that was naturally tributary to Babylon, momentous events were occurring in the north country, in and about Assyria. The growing Median power threatened its very life. Two sons of Assurbanipal, Assur-etil-ilâni and Sin-shar-ishkun, occupied the Assyrian throne, the former about four and the latter about seven years. The waves of the Umman-Manda, peoples to the north and northeast of Nineveh, were rolling over the mountains of eastern Armenia and northern Media. According to an inscription of Nabonidus, written about 553 B.C., these mountaineers finally succeeded in overwhelming Nineveh, the last hiding-place of the Assyrian tyrant and oppressor, in 606 B.C.; this was done probably with the direct or indirect support of Nabopolassar of Babylon.

Nebuchadrezzar II. 604–561 B. C.—Simultaneously with the fall of Nineveh we find an Egyptian army under Necho encamped in northern Syria, in full possession of the eastern coast of the Mediterranean Sea. In a crushing defeat Nebuchadrezzar overthrew and pursued the Egyptian invaders, and secured that territory for the new Babylonian empire. Within the 44 years of his reign, Nebuchadrezzar made Babylon the up-to-that-time greatest of empires. His authority extended, on biblical evidence, even into Egypt, and his activities were something phenomenal. In fact, the larger part of his inscriptions already found are devoted to his immense building projects, including temples, palaces, streets, embankments, and walls. Babylon was built in great magnificence, and in every important aspect did credit to the enterprise and genius of Babylonia's greatest monarch. His own records thus far found do not give us any account of his dealings with the Jews, either at Jerusalem or those in exile,— described in the Old Testament. After a long and prosperous reign he was succeeded on the throne by his son, Evil-Merodach. This king was assassinated after a reign of two years (561–560 B.C.), by Neriglissar, his brother-in-law. This usurper ruled four years (559–556 B.C.), and spent most of his time, according to his inscriptions, in building operations. At his death, his son, Labashi-Marduk, not yet of age, succeeded him, but fell under the assassin's knife within nine months.

Nabonidus, 555–538 B. C.—By some machinations of the priesthood, apparently, the new king, Nabonidus, was a native Babylonian and not a Chaldean as was the dynasty of Nabopolassar. He was an enthusiastic religionist and antiquarian. He built and rebuilt many temples in the principal cities of his kingdom. He was the discoverer, in the foundations of a temple, as already stated, of an inscription of Sargon I., which had been placed there 3,200 years before his day, making the date of said Sargon about 3750 B.C. Nabonidus' enthusiasm carried him too far, for he attempted to centralize in Babylon the religion of the kingdom. In doing this he alienated the priesthood, and even aroused their active opposition. For throughout the history of Babylonia each city had had its own patron deity, to whom its temple was dedicated and its people devoted. The images and shrines of these various divinities were collected in Babylon. This act, with others of similar offense to the priests paved the way for his downfall before a mightier power.

Cyrus, 538–529 B. C.—Cyrus, an Elamite and Persian by descent, began an active career as a conqueror in 558 B.C. He conquered successively the Medes under Astyages (550 B.C.),

Crœsus and Asia Minor (547 B.C.), and then moved against Nabonidus, who had allied himself against this new conqueror. The Babylonian army was probably under the command of Nabonidus' son, Belshazzar. Suffering a defeat at Opis, the army of Babylon later scarcely offered resistance. Cyrus marched, almost without further opposition, to the gates of the capital city. The outraged priesthood and citizens, in open defiance of their own king, flung open the gates and welcomed the new and liberal conqueror to authority over them. Cyrus restored the gods to their cities and shrines, and permitted enforced exiles to return to their native places and lands. Besides, he became one of the ardent worshippers of the gods of the land, and established himself as a liberty-loving, people-serving potentate.

The fall of Babylon before the advance of Cyrus meant the fall of Semitic sway in Babylonia, and the rise of Aryan power. The cuneiform tongue served the purpose of a language in Babylonia for long years after this revolution. In fact, throughout the Persian and Greek periods, this same language was used in Babylonia, particularly in writing contract tablets. There are some inscriptions dating from the Parthian era, due doubtless to the enthusiastic support of the priesthood of those times. Thus for nearly or quite 4,000 years the cuneiform language was the vehicle of expression for the peoples of Babylonia.

Bibliography.—The literature on Babylonia-Assyria has already become voluminous. Consequently, in a limited bibliography, only selections will be given. These will cover the following departments of study:

(1) *Explorations and Discoveries.*—These include the early works of C. J. Rich, J. E. Taylor, A. H. Layard, P. E. Botta, Felix Jones, W. K. Loftus, and J. Oppert. Since 1870 the most important works are those of Geo. Smith, H. Rassam, E. de Sarzec, John P. Peters, H. V. Hilprecht, and M. J. de Morgan, freely cited in all works on discoveries in those lands.

(2) *Inscriptions and Texts.*—Cuneiform texts began very early to be published. The first notable publication was Rawlinson's text and translation of the Behistun Inscription in the 'Journal of the Royal Asiatic Society' (Vol. X., 1847). Botta, Layard, and Oppert also published inscriptions as a result of their explorations and excavations. H. C. Rawlinson edited (1861–84) for the trustees of the British Museum five standard volumes of texts under the title 'Cuneiform Inscriptions of Western Asia.' Many minor series have appeared since that date, such as 'Assyriologische Bibliothek' (1881—), edited by Delitzsch and Haupt; 'Babylonian Expedition of the University of Pennsylvania,' by H. V. Hilprecht (1893—); 'Cuneiform Texts in the British Museum' (1896—), by officials of that museum; 'Découvertes en Chaldée' (1884—), by E. de Sarzec; eight volumes of 'Assyrian-Babylonian Letters' (1892—), by R. F. Harper, and 'Mémoires de M. J. de Morgan' at Susa, in which V. Scheil has edited notable Susian texts, and the Code of Hammurabi. In addition to these there are scores of lesser texts of value to the student.

(3) *Equipment for Study of the Language.*—The former dearth in this field has been largely supplied by Frdr. Delitzsch. His 'Assyrische Lesestücke,' 4th edition; his 'Assyrian Grammar' (1889), 'Assyrisches Wörterbuch' (1887—), and 'Assyrisches Handwörterbuch' (1896), constitute a fairly good outfit. Other works helpful in the same line are D. G. Lyon's 'Assyrian Manual' (1886), Brünnow's 'Classified List of Cuneiform Ideographs' (1889), Muss-Arnolt's 'Concise Dictionary of the Assyrian Language' (1894—); L. W. King and H. Winckler have likewise contributed liberally to this department of work.

(4) *Translations, Commentaries, etc.*—There is a long list of this material, but some of the most useful for modern students are 'Records of the Past' (1888–92), new series, edited by A. H. Sayce; 'Keilinschriftliche Bibliothek' (1889—), edited by E. Schrader; 'Assyrian and Babylonian Literature' (1901), edited by R. F. Harper; 'Zeitschrift für Assyriologie' (1886—), edited by C. Bezold; several volumes in Delitzsch and Haupt's 'Assyriologische Bibliothek,' already referred to; 'Kosmologie der Babylonier,' by P. Jensen; and several admirable series just issued by L. W. King and R. C. Thompson of the British Museum, and by C. H. W. Johns of Cambridge.

(5) *Learning, Religion, Art.*—Selections only: Fr. Lenormant, 'Le Magie chez les Chaldéens' (1874); ———, 'La divination et la science des présages chez les Chaldéens' (1875); F. Hommel, 'Die Vorsemitische Kulturen in Ægypten und Babylonien' (1883); A. H. Sayce, 'Religion of the Ancient Babylonians' (Hibbert Lectures, 1887); 'Higher Criticism and the Monuments' (1st ed. 1893, several later editions); A. Jeremias, 'Babylonische-assyrische Vorstellungen vom Leben nach dem Tode' (1887); C. P. Tiele, 'Geschichte d. ægyptische u. d. babyl.-assyr. Religion' (1895); M. Jastrow, Jr., 'Religion of Babylonia and Assyria' (1898, new revised ed., 1905, appearing in German); H. Zimmern, 'Beiträge zur Kenntniss der Babylonischen Religion' (1901); Perrot and Chipiez, 'Histoire de l'art dans l'antiquité,' Vol. II.: 'Chaldée et Assyrie' (1884); older works, such as those of Botta, Layard, and Place, are of value chiefly for their illustrations.

(6) *History and Archæology.*—Some of the most recent works superseding the large work of George Rawlinson are G. Smith, 'History of Babylonia,' edited by Sayce (1877); G. Smith, 'Assyria from the Earliest Times to the Fall of Nineveh' (1875); F. Hommel, 'Geschichte Babyloniens u. Assyriens' (1885–9); C. P. Tiele, 'Babyl.-Assyrische Geschichte' (1886–8); H. Winckler, 'Geschichte Babyl. u. Assyriens' (1892); J. F. McCurdy, 'History, Prophecy and the Monuments' (1894–1901); R. W. Rogers, 'History of Babylonia and Assyria' (1900); G. S. Goodspeed, 'History of the Babylonians and Assyrians' (1902); Schrader-Whitehouse, 'Cuneiform Inscriptions and the Old Testament' (1889); Schrader-Winckler-Zimmern, 'Die Keilinschriften und das Alte Testament' (3te auflage, 1901–3); Ira M. Price, 'The Monuments and the Old Testament' (4th ed. 1905); A. Jeremias, 'Das Alte Testament im Lichte des alten Orients' (1904).

Further bibliographical material may be found in the periodicals devoted to Assyriology, 'Zeitschrift für Assyriologie,' the 'American Journal

of Semitic Languages and Literatures,' and 'Orientalische Bibliographie'; also in the comprehensive articles on "Assyria" and "Babylonia" by Hommel and King in Hastings' 'Dictionary of the Bible,' and Cheyne's 'Encyclopædia Biblica,' respectively.

IRA MAURICE PRICE,
Professor of Semitic Languages and Literatures, The University of Chicago.

Ast, äst, **Georg Anton Friedrich,** German scholar and philosophical writer: b. Gotha 29 Dec. 1778; d. Munich 31 Oct. 1841. In 1805 he was appointed to the chair of Classical Literature at Landshut, and in 1826 accepted an appointment to the same chair in the University of Munich. Among his best known publications are: 'Handbuch der Aesthetik' (1805); 'Grundriss der Geschichte der Philosophie' (1807); 'Wissenschaftliche Darstellung der Grammatik, Hermeneutik und Kritik' (1808); 'Platos Leben und Schriften' (1816). He also published an edition of the works of Plato in eleven volumes with a Latin translation and a commentary (1810–32).

Astacus (Ital., *astaco,* Lat., *astacus,* Gr., **ἀστακός**), a genus of decapod *Crustaceans* of the family *Astacidæ,* including the *A. marinus,* or lobster, and the *A. fluviatilis,* or crayfish. The species *A. fluviatilis* contain the crayfishes of Europe, and also those of the Pacific States of the United States, while those found along the Atlantic coast belong to the species *Cambarus.*

Astarte, ȧs-tär'tē, a character in Byron's play, 'Manfred.' The hero guiltily falls in love with her, and in the second act her shadow appears to him in a denunciatory attitude.

Astar'te, a genus of bivalve mollusks belonging to the family *Cyprinidæ.* They have 2-2 hinge teeth, and are suborbicular, compressed, thick, smooth, or concentrically furrowed shells. Tate estimated the recent species known at 20 and the fossil at 285. The former belong to the Temperate and Arctic zones, and the latter to the rocks from the carboniferous formation upward.

Astarte, as-tär-te, or **Ashtoreth,** a Syrian goddess, probably identical with the *Semele* of the Greeks, and the Ashtaroth of the Hebrews, and worshipped also by the Phœnicians, and Carthaginians, being regarded by some as the original of the Greek goddess *Aphrodite* (*Venus*). She was the moon-goddess, or goddess of the heavens, and appears also to have been worshipped as the goddess of fruitfulness. In the Old Testament, Astarte is frequently mentioned as the goddess of the Sidonians (see 1 Kings xi. 5–33; 2 Kings xxiii. 13), but the form of her name seems to have been perverted, to her original name of Ashtart being infixed the vowels of Bosheth, or "shame," and we find her there called Ashtorath. In 1 Samuel xxxi. 10, Astarte is again mentioned, as is also the fact that a temple was built to her at Ashkelon. There were also temples at Citium in Cyprus, at Eryx in Sicily, and in Carthage. The Syrians also built a famous temple to her at Hierapolis, at Tyre, and at Sidon. She is probably identical with the Assyrian goddess Ishtar, or Istar, the "Lady," the "Queen of the Gods" or the virgin goddess of death and war, who enforces strict chastity upon her priests and priestesses. Astarte is represented in various forms, but more usually with four wings, the two uppermost representing the horns of the moon, and having on her head a pointed cap, and a white dove in her hand. Others represent her as a naked female figure, short and stout, and the hands holding the breasts. She is also represented in Phœnicia as a cow.

Astatic (as-tat'ĭk) **Needle** (Greek, "unstable"), in physics, a magnetic needle whose tendency to set itself in the magnetic meridian has been nearly or quite neutralized in some way, so that while the needle retains its full magnetic power, it will remain indifferently in any position, even when quite free to turn. A magnetic needle may be made astatic in various ways; for example, by disposing magnets in the vicinity of the needle in such a way that their field of force opposes and neutralizes the earth's field. A commoner method is to make use of a pair of needles of equal size and equal magnetic strength, securing them together, one above the other, by a light, rigid connection, so that their lengths shall be parallel, and their poles turned in opposite directions. If the conditions here assumed are fulfilled rigorously, the system will have no directive tendency whatever. In practice it is quite possible to secure an adjustment so good that the directive tendency is masked by the torsional force of the suspending fibre. Astatic needles are used in the construction of delicate galvanometers, the coil conveying the current passing around only one of the needles of the system, or around both of them, in opposite directions. The full magnetic moment of the current is thus obtained, while the directive action of the earth's field remains practically zero, and the motion of the needle is opposed only by the torsion of the suspension. See GALVANOMETER.

Asten, äs'tĕn, **Friedrich Emil von,** German astronomer: b. Köln 1842; d. 1878. From 1870 he was employed at the Imperial Russian Observatory at Pulkowa. He will be best remembered for his work upon Encke's comet, the results of which were published in 1877, and included an elaborate discussion of all the appearances of this interesting body from 1819 to 1875.

Aster, äs'tėr, **Ernst Ludwig von,** German military engineer: b. Dresden 5 Oct. 1778; d. Berlin 10 Feb. 1855. His first service was in the Saxon army. It was in 1810, as an officer in this army, that he submitted his plans, subsequently accepted, for the fortification of Torgau to Napoleon. Subsequently he entered the Russian service, and, soon after 1815, the Prussian. While in the last service he undertook the fortification of Coblentz and Ehrenbreitstein, and in 1842 was appointed general and inspector of all the Prussian fortresses.

As'ter, a genus of plants belonging to the natural order *Compositæ,* and comprehending several hundred species, mostly natives of North America, although some of the species are found over most regions of the globe. The name is derived from the Greek aster, a star, and is due to the fact that the flowers (*capitula*) bear some resemblance to stars. The species are herbaceous plants, or more commonly

shrubs. On account of the large number of species composing this genus it is divided into six or seven groups, regarded by some botanists as forming distinct genera. Large as the genus is, it contains no species of any great utility in the arts, but many are cultivated as ornamental plants. The most beautiful species among those which are natives of Europe are the *A. alpinus, amellus,* and *pyreneus,* and among those of America, *A. grandiflorus, punicaeus, eminens, multiflorus, horizontalis, thyrsiflorus, roseus,* and *Novæ Angliæ.* The China aster (*A. chinensis*), introduced from China upward of a hundred years ago, is a well-known annual, growing to a height of from 12 to 18 inches, and bearing an abundance of large and beautiful flowers, exhibiting in the numerous varieties every hue except yellow, and a great diversity of marking. This plant lends itself readily to culture and florists are constantly adding new varieties to a stock that already numbers nearly 300. The French call this species Reine Marguerite. Some botanists refer it to a separate genus which they call *Callistephus.* The chrysanthemum and peony flowered varieties are particularly worthy of cultivation for the size, color, and abundance of their flowers. From the lateness of the season in which they bloom some species of aster have obtained the name in England of Christmas daisy. Of the species commonly cultivated in gardens, several bloom in July, and a few continue in flower from November until killed by frost, or the beatings of violent storms.

Asterisk («a little star»), a sign or symbol (*) used in writing and printing, as a reference to a note at the bottom or on the margin of the page. The obelisk, or dagger (†), and many other marks, are similarly employed; but when there are several references on the same page, it is now common to use the numerals 1, 2, 3, etc. The asterisk often marks the omission of words or sentences, or it distinguishes words as conjectural or obscure, or it may be used merely as a typographical mark for any specified purpose.

Asterism, a property possessed by a few minerals of exhibiting star-like rays. It is due either to reflection of light from twinning lamellæ or minute enclosed tubes, as in the case of star-sapphire (q.v.), star-ruby, and star-quartz (q.v.), or to the regular arrangement of minute enclosed crystals as seen by transmitted light, in the case of some phlogopite or star-mica.

Asteroidea, an order of *echinoderms,* the starfishes, so called because of their star-like shape. They are characterized by five or more arms, which they have the power to reproduce if broken off. Should one of these arms be entirely detached, taking a small portion of the body with it, a new fish will result.

Asteroids, a group of small planetary bodies, known also as minor planets, which revolve round the sun between the orbits of Mars and Jupiter. The most remarkable feature of these bodies is that they occupy a vacant place in the solar system in which a planet would naturally belong. Between the orbit of Mars, the fourth planet in order, and that of Jupiter the fifth, there is a space more than double the radius of the orbit of Mars itself. This gap was noticed from the time that the distances of the planets were laid down by Kepler. It was long suspected that a planet would be found occupying it and an organized effort was made to discover it. The discovery of a planet which was supposed to be the long sought body was made by Piazzi, at Palermo, on the first day of the 19th century. To the great surprise of astronomers three other planets were found in the course of the next six years to be revolving in the same region. The smallness of the four bodies gave rise to the celebrated hypothesis of Olbers, that these bodies were the fragments of a single planet which had been disrupted by some cataclysm. Some 40 years elapsed when in 1846 a fifth asteroid was discovered. Others soon followed. More powerful telescopes were applied to the search, a thorough system was introduced, and in this way the number known went on increasing until it mounted into the hundreds and now a dozen or more are frequently added to the list in a single year.

When photography was applied to form a permanent picture of the stars in the sky, it was found that this method was the easiest by which discoveries of these objects could be made. Whatever method may be used, the difficulty of discovering an asteroid arises from the fact that it is impossible to distinguish such a body from a fixed star by its mere aspect. It can be detected only by its motion among the stars, and therefore requires that the same body should be observed at different times. But a photograph enables the motion to be detected in a very simple way, as follows:

If a telescope, mounted so as to serve as a camera, is pointed at a given region of the sky for half an hour or more, the images of the stars which fall on the plate remain immovable, and these bodies are photographed as simple points of light. But if an asteroid is in the field, its motion during the exposure is quite appreciable; and its picture appears as a short line, equal in length to the amount of motion during the exposure of the plate, which can be detected at sight. During the last ten years the number thus discovered has carried the total list up to more than 500, a number so great that it is almost impossible to compute the orbits or motions or even to find separate and appropriate names for the bodies.

The asteroids are distinguished from the major planets by several distinct and interesting features. One of these concerns their orbits. While the major planets, with the exception of Mercury, all move in nearly circular orbits, the orbits of the asteroids are, in the general average markedly eccentric. In some cases the asteroid is twice as far from the sun at aphelion as at perihelion. One result of this is that they appear several times brighter when seen in opposition at perihelion than at aphelion. The inclination of the orbits is also frequently very large. That of Pallas, one of the original four, is inclined no less than 34° to the elliptic. The result of this is that many of these bodies wander far outside of the limits of the Zodiac; indeed, in many cases they are seen north of the zenith in our latitudes when nearest the earth.

The size and mass of the asteroids do not admit of very accurate definition, for the reason that, with rare exceptions, they are seen in the telescopes only as points of light. Barnard, has, however, succeeded in measuring the apparent diameter of the first four, three of which are

probably the largest of the group, with the great Lick telescope. The results are:

	Miles
Diameter of Ceres	485
Diameter of Pallas	304
Diameter of Vesta	243
Diameter of Juno	118

Only the largest shows a diameter exceeding one twentieth that of the earth, and all the others are much smaller than this. Judging from the amount of light they reflect very few of them are 100 miles in diameter and most of those known may not exceed 10 or 12 miles in extent. Indeed, we have reason to believe that as we take smaller diameters the number increases without any unit. The same remark might apply in a still greater extent to the masses. The latter are so small that the attraction of the whole mass of all the asteroids does not produce any effect that has yet been observed upon any planet or comet.

Of the total number of these bodies it is hardly possible to form any estimate, because the more powerful the means of research the more are found. We can hardly be astray in supposing that thousands exist, and if we include those that must forever remain invisible to us, the number must be countless. Yet they are all so minute that the total mass cannot be as great as that of the planet Mercury.

The hypothesis already mentioned, that these bodies are fragments of a great planet, has been effectually disproved by modern research. Apart from the impossibility of an explosion which would rend a planet, we have the fact that in the event of a disruption all the orbits would pass through a single point. It is true that this coincidence would not continue indefinitely, because the orbits would change their positions by the attraction of the other planets; but their sizes are found to be such that they could not originally have passed through any single point. The view now prevalent is suggested by the nebular hypothesis, which assumes that all the planets were at some remote epoch in the past spread out into rings of matter circulating around the sun. In the case of the eight major planets each ring condensed into a single body, but in the case of the asteroid ring it separated into countless small bodies instead of condensing into one. There is a curious grouping of the orbits which seems to have some connection with the origin of the whole collection. Thirty years ago it was noticed by Kirkwood that, if the orbits were arranged according to their mean distance from the sun, there would be gaps in the series at those points where the time of revolution was commensurable with the period of Jupiter. For example, there are no known asteroids having a period one third that of Jupiter, or one half or two fifths, although there are plenty of orbits within and outside these peculiar limiting values. The subsequent discovery of hundreds of these bodies has led to a slight modification of this law. The orbits not only seem to avoid these peculiar values, but to accumulate midway between them. To get an idea of the results suppose that every orbit stretched into a circle of a radius equal to its mean distance. Then treating these orbits as hoops, suppose that we arrange them all round on one centre. We should then find that the rings are divisible into four, five or six nearly distinct groups with vacant spaces between them. The most probable explanation seems to be that there were originally five or six different rings of matter from which these bodies condensed, instead of a single ring as in the case of the larger planets.

Perhaps the most remarkable of the asteroids was one discovered in 1898. Some of its peculiarities have excited great attention on the part of the astronomical world. The orbits of all the other known asteroids are contained between the orbits of Mars and Jupiter, no known orbits approaching very near either of these planets. But, in the summer of 1898, Witt, of Berlin, found an asteroid which at perihelion came far inside the orbit of Mars, indeed within 14,000,000 miles of the orbit of the Earth. Its orbit was found to be extremely eccentric and, which was more curious, it was interlinked with that of Mars, so that if the orbits were rings, they would have passed through each other and hung together like two links. What gives this planet especial interest is that on these rare occasions when it comes nearest to the earth its parallax can be measured with greater precision than that of any of the other planets. It therefore affords us the best possible method of directly measuring the Solar system; but, most unfortunately, it is only once or twice in a century that the nearest approach will occur. What is most tantalizing, is that only six years before it was discovered, it is known to have passed at nearly the least distance from the earth, but it was then unseen by human eye. It was found to have been photographed a great number of times at the Harvard Observatory; but among the hundreds of stars whose images were found on the plate, its image was completely lost after the discovery in 1898. It was recognized through the determination of its orbit which made possible the computation of its position in the heavens at former positions. It was by scrutinizing the photographic plates that the images were found upon them.

In the winter of 1900–1 there was as close an approach to the earth as will occur during the next 30 years, although the distance was more than double the least possible distance. A cooperative effort was made to measure the parallax on this occasion. The results are not completely worked out, owing to the immense amount of labor which is required for the reduction of the observations.

A curious property of this most remarkable body is a periodical variation in its light which was noticed during the opposition of 1900–1. It was found to go through a series of changes in the course of five hours quite similar to those of a variable star. The period was found to be 2½ hours, but possibly the same brightness was not reproduced except in a period of 5 hours. It was yet more curious that these variations seemed to have nearly or quite ceased at the next opposition.

Simon Newcomb, LL.D.

Asterolepis, a genus of ganoid fishes named on account of the starry color of its scales. A bone of a species belonging to this genus, found at Stromness, the capital of Orkney, suggested to Hugh Miller the writing of his beautiful volume entitled 'Footprints of the Creator; or, the Asterolepis of Stromness.' It was an elaborate argument against the development hypothesis. According to that hypothesis, the first species of any class appearing on the scene should be low in organization, and probably small in size. Mr. Miller showed that the asterolepis was large in size and high in organ-

ization, and yet it was at that time believed to be the oldest fossil vertebrate found in Scotland. His argument was subsequently weakened by the discovery that the Stromness rocks were less ancient than the Forfarshire beds, containing cephalaspis and other fish genera subsequently discovered, mostly of small size, though not of low organization.

Asthe'nia, a disease of poultry, known in the United States as "going light." The treatment is purgation and tonics.

As'theno'pia. See EYE.

Asthma, as'ma, or az'ma, a disturbance of the function of breathing, sometimes due to heart or kidney disease, but properly an affection of the bronchi of a spasmodic character. It is regarded as a neurotic affection, characterized by turgor and hyperemia of the mucous membranes of the smaller bronchi and a peculiar mucus exudate. The causes of the attacks are many, but a nervous element seems to enter into most of them. The symptoms are those of tightness in the chest, depression, and followed by an attack of shortness of breath, attended with violent coughing. This may be very short in duration or the coughing may continue with great violence. The expression is anxious, the face pale, or cyanosed, as though choking was taking place; the patient cannot speak, inspiration does not aerate the blood, and expiration is long and wheezy. The treatment is individual, the usual lines of dietetics, hygiene, training, with a few drugs. Iodide of potash is one of the most valuable of the remedies used. See 'Diseases of the Bronchi, Nothnagel's System' (1902).

Astig'matism, a defect of vision in which the rays of light do not converge to a single point on the retina. It is usually due to irregularities in the curvature of either the cornea or the crystalline lens, or of both, so that rays refracted in one meridian are brought to a focus at a point in advance of or behind those refracted in the meridian at right angles to the first. A slight degree of astigmatism is present in all eyes, because neither the cornea nor the anterior or posterior lens surface is part of a perfect sphere: but normally the defect is so slight as not to be noticeable. The conventional star-shaped appearance assumed by very distant points of light, as, for example, the stars themselves, is due to this universal defect. If, however, the radii of curvature are markedly unequal in the different meridians, a more or less serious blurring of the images formed on the retina by all objects results. Two main varieties of astigmatism are recognized. The commoner is *regular* astigmatism, in which there is a difference of curvature in two meridians, usually at right angles to each other, but the refraction is the same throughout any given meridian. In *irregular* astigmatism, however, there are variations of curvature along the length of the different meridians themselves; that is, each one does not, as in regular astigmatism, represent a segment of a circle. This form is usually the result of injury or disease of the cornea or lens, and is difficult to correct by glasses. Regular astigmatism is nearly always congenital and is frequently present in several members of the same family. The symptoms produced by astigmatism may be purely local and comprise blurred vision and fatigue after protracted near work, but even slight amounts may in some cases cause serious disturbances of the general health by the constant headache and reflex symptoms, such as nausea and vomiting, dizziness, etc., that result. The difficulties complained of are usually, at least partly, relieved by resting the eyes. Numerous methods of examination are employed by oculists to detect astigmatism, one of the simplest being the use of test diagrams representing radiating lines or sectors, rows of dots, etc., which, to the astigmatic eye, appear more or less blurred in certain meridians. The treatment consists in the use of glasses which are ground so as to compensate for the variations in refracting power of the optic media in the different meridians. This correction is accomplished by using cylindrical lenses, which are segments of cylinders and refract only at right angles to their axis, combined, if necessary, with the appropriate spherical lenses. See EYE; VISION, DEFECTS OF.

As'ton, William George, Irish philologist: b. near Londonderry in 1841. He became interpreter and translator to the British Legation at Yedo, in 1870; assistant Japanese secretary at Yedo, in 1875–82; consul-general for Korea, in 1884; Japanese secretary at Tokio, in 1886; and was retired in 1889. He published 'A Grammar of the Japanese Spoken Language'; 'A Grammar of the Japanese Written Language'; 'A Translation of the Nihongi; or, Annals of Ancient Japan'; 'History of Japanese Literature,' etc.

As'tor, John Jacob, American merchant: b. Waldorf, Baden, near Heidelberg, 17 July 1763; d. 29 March 1848. He came to America in 1783, where his elder brother had settled and invested his savings in the fur trade. In 1784 he went with a cargo of furs to London; sold them and formed connection with fur houses there, and as his capital increased, made annual trips to Montreal, buying furs there and shipping them direct to London, as Canada was allowed to trade only with the mother country. In 1794 Jay's treaty removed this embargo; and Astor, then in London, at once made a contract with the Northwest Company of Montreal and Quebec (then the magnate of the Canadian Northwest fur trade), imported furs from Montreal to New York, and shipped them to all parts of Europe and China. The surrender of the lake posts under the treaty also greatly extended the trading limits, and Astor in a few years became one of the leading merchants and capitalists of the country, having a quarter of a million in 1798, and double that a few years later. In 1807 he embarked in direct trade with the Indians by way of the Mohawk, and with the English fur companies; but found the American trade chiefly monopolized by the Mackinaw Company, and knowing our government's desire to keep its home trade in home hands, proposed with its protection to accomplish this himself. In 1809 he secured a New York charter for the "American Fur Company," but the War of 1812 suspended operations, and after it a government prohibition of British fur trade in the United States broke up the company. Meantime a grander scheme had been initiated. Sir Alexander Mackenzie, after crossing the Continent far north in 1793, had suggested establishing a line of trading posts from ocean to

ocean, with terminal, coast, and island stations, to draw all except the Russian fur trade into one channel. Lewis and Clarke's transcontinental American expedition in 1804 proved its practicability on American soil; and Mr. Astor evolved the plan of distributing such posts along the Missouri and Columbia Rivers, with a central station at the mouth of the latter, where all the peltries from the interior posts and those gathered by coasting vessels were to be collected, and taken by a yearly ship to Canton, loading in return with Chinese goods. A later development was to operate a line of ships from the Pacific coast to the Chinese and East Indian ports, with a Hawaiian island for an intermediate port. The Russian fur company had already complained to the United States of the casual American trading vessels selling liquor and firearms to their Indians; our government had consulted Astor for a remedy, and his idea was to abolish this irresponsible trading by making his yearly supply ship take its place. To prevent ruinous competition, he offered the Northwest Company a one third interest in the enterprise; but they declined it, and sent a company to seize the mouth of the Columbia before his party could arrive. He succeeded in spite of them, however, in planting a settlement, which was named Astoria; but on the breaking out of the War of 1812 the English seized it. It reverted to the United States by the Treaty of Ghent, and Astor wished to revive the project, but the government was cool, and he dropped it; still, however, buying his furs direct and trading with many countries, more particularly China, at that time the best fur mart in the world. He also made large amounts by buying depreciated government securities, which afterward commanded a considerable premium. But his chief investment was the one which has founded the family greatness on a rock. Foreseeing the immense growth of New York city, he bought large tracts on Manhattan Island far beyond the then city limits, taught his son to invest his accumulations in the same way, and established the system of handling them described under ASTOR FAMILY. In 1827 he and his son William, who had been his partner since 1815, withdrew from the China trade and formed the American Fur Company, chiefly managed by the great expert; but a few years later he retired from business altogether, thenceforth devoting himself to his investments, and devising, in consultation with others, plans for a public library suggested by Washington Irving, — afterward the Astor Library, for which he left $400,000 in his will. He made gifts and bequests to other objects; among them $50,000 for a school for poor children and a home for the indigent aged in his birthplace, Waldorf, called the Astor House. He was much more than a great trader: he had a breadth of conception, a combined energy and patience of execution, a mastery of detail, a retentiveness of memory, and a sagacity of judgment, which in the judgment of his intimates would have raised him to greatness in any line. He left two sons, William B. and John Jacob, and three daughters.

As'tor, John Jacob, an American capitalist and soldier, son of William B.: b. New York, 10 June 1822; d. 22 Feb. 1800. He was educated at Columbia University and at Gottingen; he then took the full course at the Harvard Law School, and practised law for a year, solely to qualify himself for assisting in the management of the immense estate, one half of which later descended to him. In the Civil War he served on McClellan's staff, with the rank of colonel; and was a devoted and hard-working military student. He always regarded this period as the best of his life, and attended the reunions of the Loyal Legion with zeal. Not only was he always a liberal giver to public institutions and charities, but he gave much personal time and devotion to them, especially to the Astor Library and Trinity Church; but he shrank from public notice. On his father's death in 1875 he received half of the estate, estimated at considerably over $100,000,000; all which, with accumulations believed to have swollen it to some $200,000,000, he left to his only son, William Waldorf Astor. His wife, Charlotte Augusta Gibbs, was an active assistant in his charitable work, taking part in personal service as "Sister Augusta," incognito.

As'tor, John Jacob, American capitalist and inventor, fourth of the name, nephew of John Jacob the third, and son of William: b. Rhinebeck, N. Y., 13 July 1864. He graduated from Harvard in 1888, and for the next three years traveled abroad. He is the manager of the Astor properties in America; a director in many banking, insurance, and railroad companies, and member of various clubs and social organizations. He built in 1897 a very costly hotel, the Astoria (named after the famous fur settlement of 1811), on Fifth Avenue, New York, adjoining the Waldorf built by his cousin, William Waldorf, the two being now joined as the Waldorf-Astoria. Besides his business activities, however, he has strong individual faculties. He is an expert in marine mechanics. inventor of a bicycle brake, and a pneumatic road improver; and is a member of scientific and other intellectual societies. He has written 'A Journey in Other Worlds: a Romance of the Future' (1894). He was on Gov. Morton's staff 1894–6, and in the Spanish-American war of 1898, was commissioned lieutenant-colonel of United States Volunteers, and served in the Santiago campaign.

Astor, William Backhouse, American merchant and capitalist, eldest son of John Jacob Astor: b. New York, 19 Sept. 1792: d. 24 Nov. 1875. He was trained in his father's business in the intervals of public school education: and the father is said to have remarked that "William would never *make* money, but would keep what he had." At 16 he was sent to Heidelberg University, and at 18 went to Gottingen, where he was tutored by Bunsen, afterward the great chevalier. Returning to New York in 1815, he was made a partner in his father's foreign shipping trade, especially cultivating the Chinese field. The firm was John Jacob Astor & Son till 1827, when it dissolved and both partners gave up the China trade to form the American Fur Company, of which William was president, but John Jacob the head manager till he withdrew from active business life a few years later. He was shortly followed into retirement by his son. By 1848 he had amassed a fortune of his own; besides receiving a legacy of half a million from his uncle Henry, and a gift of the Astor House

from his father; the latter on his death in that year leaving him sole legatee save for minor bequests, the property being estimated at $20,000,000 to $30,000,000. His life thenceforth was spent in conserving and developing this. He built nearly a thousand houses on his uptown lots, and was currently termed "the landlord of New York." He was also a heavy investor in other lines, notably coal and railroad stocks. He founded the Astor Library under his father's bequest, adding by gifts and bequests over $600,000 to his father's gift, giving much time to its administration from the completion of the building in 1853 on his plans. His wife was the daughter of Madison's second secretary of war; his sons were John Jacob and William, and the estate was shared between them.

Astor, William Waldorf, an American capitalist, son of John Jacob the third: b. New York, 31 March 1848. He is the head of the chief Astor estate. He was educated by private tutors; studied law to qualify himself for the management of his estates, and assumed it in 1871. He was elected to the New York State lower legislative chamber in 1877, and to its Senate in 1879; and was an unsuccessful candidate for Congress in 1881. In 1882 he was appointed minister to Italy by President Arthur, and remained such till 1 March 1885. He made literary capital out of this in 'Valentino' (1885) and 'Sforza' (1889). He succeeded by his father's death in 1890 to a fortune estimated at some $200,000,000, and the same year removed to London. Shortly afterward he built the famous and costly New York hotels, the New Netherland and the Waldorf. In 1893 he bought the 'Pall Mall Gazette' and founded the 'Pall Mall Magazine,' and in 1899 took the oath of allegiance as an English subject.

As'tor Family, a famous American family representing one of the three or four greatest private properties in the world. A family in the Old World sense,— a territorial aristocracy, impossible to destroy, and fortified with legal immunities and privileges,— can hardly be founded in America; but the Astors have approached it as nearly as our institutions will admit. They form a group of immense hereditary real-estate owners, with holdings so solidly based and well distributed in the metropolis of America that no apparent catastrophe save a failure of heirs could extinguish it; and though originally springing from mercantile business, removed by some three quarters of a century from its actual conduct. For many years they were known as "the landlords of New York," and the best of landlords, prompt, just, and courteous; still probably form the largest set of individual real-estate holders. The family is also connected with notable municipal charities and public foundations. See Astor, John Jacob (1763–1848); Astor, John Jacob (1822–90); Astor, John Jacob (1864–); Astor, William.

Astor Library. See New York Public Library.

Astor Place Riot, in American history: a riot on the evening of 10 May 1849, in Astor Place, New York. It was an attempt to drive the English actor, William Charles Macready (q.v.) from the stage, and grew out of a London tour of Edwin Forrest (q.v.), in which he played Virginius and Richelieu with great success till Macready bought the acting rights for himself, though he had personally treated Forrest with kindness. Forrest then essayed Macbeth, but it was unsuited to his style and presence, and he was hissed. He attributed this to Macready's machinations, and when Macready four years later announced 'Macbeth' in the Astor Place Opera House, a crowd of Forrest's partisans gathered early in the evening before the theatre, and waiting till the performance had begun, attempted to force a way inside and put a stop to it. The police were powerless and sent for the military; the Seventh Regiment (New York militia) came up, and was assailed by the mob with showers of brickbats and stones. Before the fray was ended, 34 rioters were killed, a great number wounded, and 141 of the regiment injured by the missiles. The mob was successful in its purpose, however: Macready had to cancel his engagement, conceal himself in a private house for a couple of days, and then travel secretly to Boston, whence he sailed for England. See Barrett, 'Edwin Forrest' (1882).

Astor'ga, Emanuele d', an Italian composer: b. Palermo, 11 Dec. 1681; d. 21 Aug. 1736. He was educated in a monastery in Astorga in Spain, from which he afterward took his name. A 'Stabat Mater,' which he is said to have written in London, is considered the best of his works, and is still highly regarded.

Astorga, as-tōr'ga, a city in Spain, the *Asturica Augusta* of the Romans. It figured prominently during the Peninsular war; was taken by the French after an obstinate defense, 1810; and retaken by the Spaniards, 1812. It is the see of a bishop. Pop. 5,000.

Astoria, Or., a city, port of entry, and seat of Clatsop County: on the Columbia River, nine miles from its mouth, and 101 miles by the Astoria & C. R. R.R. from Portland. Several foreign steamship lines touch here, the largest vessels coming up to its five miles of water frontage through the deep, broad channel scoured in the bar at the river mouth by a jetty. Its salmon fishing and canning industries are among the greatest in the world: several hundred boats go out to the fishing grounds on the bar every afternoon during the season of about 100 days, some 1,500 in all being employed; and the canneries utilize some $2,000,000 capital, and turn out about 15,000,000 cans a year. It has also subsidiary can manufactories and iron works, great lumber works from the vast forests of the Pacific slope, flouring mills, breweries, etc.; and has a very large export trade in the special products of Oregon and Washington — lumber, wheat, oats, live stock, wool, potatoes, apples, etc. Among its buildings, the most notable are the United States custom-house, the post-office, and St. Mary's Hospital (R. C.). For the founding of Astoria in 1811, see Astor, John Jacob. On its seizure by the English in the War of 1812, they renamed it Fort St. George; in 1818 it was restored to the United States, though occupied till 1845 by the fur stations first of the Northwest Company, then of the Hudson Bay Company with which the former consolidated. It received a city charter in 1876. Pop. (1900) 8,381.

Asto'ria, or Anecdotes of an Enterprise Beyond the Rocky Mountains, a rambling

work by Washington Irving (1836). It comprises stories of expeditions by land and sea, and as a chapter of Far West history, does not lose its value by the lapse of time.

Astrabad, äs'tra-bäd', a town of Persia, about 30 miles east of the Caspian Sea. It carries on a trade in horses, sheep, cotton, silk, woolen fabrics, etc., and is connected by caravan with Afghanistan and is the seat of a Russian consulate. Pop. estimated at from 4,000 to 10,000.

Astræ'a, in mythology, the daughter of Zeus and Themis, and goddess of justice. In the age of gold she was a regular inhabitant of this world; in the age of silver an occasional visitor; and in the age of brass, when men began to forge weapons of war, fled to the skies, where she is seen in the zodiac, forming the constellation Virgo. She is usually represented with scales in her hand and a crown of stars on her head.

Astræ, The Divine, a name applied to the English novelist and dramatist, Mrs. Aphra Behre, who was noted for the coarseness of her plays. "The stage how loosely doth Astræa tread."

As'tragal, in architecture, a small semicircular molding, with a fillet beneath it, encircling a column and separating the shaft from the capital.

As'tragaloman'cy (Greek *astragalos,* in the plural = dice, and *manteia* = divination), a pretended divination performed by casting down dice with marks corresponding to letters of the alphabet, and observing words thus formed. It was practised in the temple of Hercules, in Achaia.

Astragalus. See Foot.

Astrag'alus, Milk Vetch, a genus of more than 1,000 species of hardy leguminous herbs and under shrubs which, except in Australia where they have not been found, are of world-wide distribution on dry soils. *A. gummifer* and other species yield tragacanth (q.v.) gum. Certain species native to the western United States called crazy weeds (q.v.) are considered responsible for crazy disease of stock. The leaves are usually pinnate; the flowers arranged in racemes, white or purple. A few native and foreign species are grown from seed for ornamental purposes. They succeed best on dry, porous soil in sunny situations.

Astrakhan, äs'trakhän', a government in the southeast of European Russia, on the Caspian; with an area of about 92,000 square miles. It consists almost entirely of two vast steppes, separated from each other by the Volga, and forming for the most part arid sterile deserts. The live stock consist chiefly of sheep of the broad-tailed species. The chief employments are pasturage and fishing — the former occupying the rural and nomadic tribes, and the latter the tribes on the Caspian coast and the banks of the Volga. Pop. (1897) 994,775.

As'trakhan', the capital of the Russian government of the same name. It is situated on an elevated island in the Volga, about 30 miles above its mouth, and consists of crooked, dirty, but broad streets, with irregular lines of houses. The communication with the opposite banks of the river is maintained by numerous bridges. The most important edifice is the cathedral, of a rectangular form, with four small gilt and painted cupolas on the roof, and a large one in the centre. The manufactures, consisting of silks, cottons, woolens, shagreen skins, morocco leather, and soap, are increasing in extent. The fisheries furnish the staple articles of trade. Immense quantities of fish, caviar, and isinglass are exported to foreign countries. In the fishing season from 20,000 to 30,000 persons connected with the fisheries frequent the city. It is the naval station of the Caspian fleet; is the most important port of the Caspian, and has regular steam communication with the principal towns on the shores of that sea. Pop. (1897) 113,001.

As'trakhan', a name given to sheep-skins with a curled wooly surface obtained from a variety of sheep found in Bokhara, Persia, and Syria, and also to a rough fabric with a pile in imitation of this.

As'tral Spir'its, spirits believed by the Greeks and Orientals to inhabit the heavenly bodies or the aërial regions. In the Middle Ages they were variously conceived as fallen angels, souls of departed men, or spirits originating in fire, and belonging neither to heaven, earth, nor hell. Paracelsus regarded them as demoniacal in character.

As'trapothe'rium, an extinct hoofed animal found in the Miocene formations of Patagonia. It is unlike any modern animal, but is distantly related to the extinct Toxodonts of South America. It was as large as a rhinoceros, had large tusks opposing each other in the upper and lower jaws, and a broad flexible muzzle like that of the hippopotamus, or possibly a short proboscis like that of the tapir.

Astringents. Substances that have the property of precipitating albumin and other proteids act as astringents. When used on mucous membranes they contract the tissues, diminish the blood supply, decrease the mucus and modify the sense perceptions in the part. In the mouth they cause the well-known sensation of puckering. Their action is purely local. Vegetable astringents all contain tannic acid, to which substance their action is due. Nearly all of the mineral salts are astringent when used well diluted with water. In concentrated solution their coagulant action is so pronounced as to cause death of the tissue (caustic). The astringents are particularly serviceable in stimulating atomic mucous membranes, causing them to secrete less mucus. They are thus useful in chronic diarrhœas, in leucorrhœa and in mucous discharges from other parts of the body. The most serviceable of the vegetable astringents is tannic acid, or its compounds, tannalbin, tannigen, and related bodies. Of the mineral salts, solutions of copper sulphate, zinc sulphate, lead acetate and the aluminum salts are the most useful.

As'tro-photog'raphy. It seems likely that attempts to photograph the moon were made by Daguerre in the course of the experiments which led to the first successful method for making optical images permanent. Certainly in 1840 Draper, of New York, obtained a crude and imperfect picture of the moon, after a prolonged exposure of the Daguerreotype silver plate. In 1851, and the years immediately following, the collodion wet-plate process was introduced and

developed. By this method De la Rue, Draper, and Rutherford were enabled to produce pleasing photographs of the moon. Much advance was made, during the same period, in the application of photography to other celestial objects, but it cannot be said that the results, on the whole, were other than interesting and suggestive. Obviously, however, the work was full of promise of better things, and the modern developments along this line afford an impressive illustration of the growth of a scientific toy into a potent instrument of research. In the early seventies the gelatine dry-plate became generally available, and from that time astronomical photography has steadily grown in effectiveness and applicability. In outline, astronomical photography is like any other photography. By means of a suitable lens an optical image of whatever is to be photographed is thrown upon the sensitive plate. It is immaterial whether the object be a landscape, the moon, an animal, or a constellation. After an exposure whose duration is determined by experience, the plate is removed and "developed" by any of the well-known processes. The result is a reproduction, in light and shade, of the optical image. From this plate, called a "negative," may be made prints, transparencies, etc. The obstacles met with, however, in carrying out this apparently simple process when applied to celestial objects, are many and great. On account of the rotation of the earth, the heavenly bodies are seemingly in motion from east to west. Some of them, moreover, have sensible motions of their own. Thus it is necessary to provide compensating motions for the camera or photographic telescope so that the image shall remain in the same place on the plate during exposure. This is a mechanical problem of great difficulty. Again, the camera must be used from the bottom of a deep atmospheric ocean turbid with smoke, dust, ice-crystals, and vapors, and swirling with currents and eddies. This obstacle is the most serious one in all astronomical work. It becomes more and more disastrous as the magnifying power of instruments is increased, and is but imperfectly overcome by careful selections of sites for observatories, and of times for work when the air is relatively quiet. There are many other difficulties which attend the processes of practrical astronomical photography, but these two are fundamental. On the other hand, there are at least two fundamental advantages in the photographic method as compared with the direct visual method of studying the sky. When measurements are to be made — such as, for example, the measurement of the angular distance between two neighboring stars — the direct method often calls for careful, accurate work under trying conditions. The observer may be hurried, in a constrained attitude, or shivering with cold. Checks by a second observer may be of doubtful value on account of personal equation or changed conditions. If, however, the two stars be photographed on the same plate, the measurements may be made at leisure, in physical comfort, and with every precaution for insuring accuracy. In the second place, the effect of light-vibrations upon the sensitive substance of the photographic plate is cumulative. That is the longer the plate is exposed the greater the effect of the light upon it. (There is, no doubt, a maximum, but it lies outside the range of photography.) Upon the retina of the human eye, however, or upon the optic nerve, there is no such cumulative result. We gain nothing by looking for a long time toward an object whose light is too feeble to affect the sense of vision. When, after a while, we see an object not previously discerned, it is because the attention is directed to it, not because the retina is more affected.

It is on account of this property of the photographic plate that prolonged exposures have revealed faint objects or peculiarities of structure, not visible to the keenest eyes aided by the most powerful telescopes. As an important though subsidiary advantage of the photograph, may be mentioned the possibility of presenting to the sight enlarged representations of relatively extensive celestial areas. The field of vision of a great telescope is very small. A photograph of a nebula or of a star-cluster, projected by a fine lantern, at once exhibits a convincing general view, revealing things in structure and arrangement which might long escape the notice of one studying the object with a telescope. The difference is much the same as that between a broad view of a landscape and the same examined through a long tube of small diameter. Photography is at present employed in almost every line of astronomical research. The general divisions of the subject are, however, indicated in what follows.

Star Charts.— By agreement among the authorities of some score of observatories in different parts of the world, there has been undertaken the enterprise of photographing the entire heavens. The plates are of uniform size, and the lenses used are as nearly as possible identical in figure. One set of photographs is to include stars down to the eleventh magnitude, while a second set is to include everything that can be secured by the longest practicable exposure. The value of the resulting charts to the astronomy of the future can scarcely be overestimated. Had such a map been constructed a few centuries ago it would now throw great light on problems relating to the structure of the universe. Meantime the study of the photographs already secured has been of importance in modifying theories as to the distribution of the stars, in revealing asteroids, new stars (so called), and variable stars.

Photographs for Detail.— Up to the present time the greatest success in this line of endeavor has been attained in photographing the moon, the sun, and nebulæ. The superb lunar photographs produced at the Lick Observatory and at the Observatory in Paris leave little to be desired, although they are inferior to the best views obtained by the direct use of the telescope. These wonderful pictures cannot fail to be of great future value in showing to what extent, if at all, changes take place on the surface of our satellite. The photographs of the sun are, thus far, somewhat less satisfactory as to minute details. The air between the observer and the sun is almost constantly disturbed, and it is not easy to take advantage of instants of "good seeing" for securing the pictures. Nevertheless the accumulations of solar photographs, taken as they are every day, constitute a most admirable history of what goes on in the sun's surface and help toward a correct understanding of solar physics. At recent total solar eclipses many

thousands of photographs of the corona have been secured. These naturally differ widely in scientific value, but it must be admitted that the best of them fall short of revealing all that is seen by the eye. The "fogging" of the plates from the light in the atmosphere in the solar direction obscures the image of the outer corona. The eye recognizes this faint extension rather by its tint than by its luminosity as compared with that of the sky. Photographs of the nebulæ, on the other hand, taken by prolonged exposures on moonless nights, have greatly advanced our knowledge of the structure of these objects, and have led to modifications in the statement of the nebular hypothesis. Photographs of the planets have thus far failed to give satisfactory results in exhibiting surface markings.

Photographs for Measurement.— Aside from the construction of star-charts as described above, the photographic method is used in an increasing number of cases in which the most accurate angular measurements are desired, and is now fairly comparable with the heliometer method. Among the more important applications of the new process is the determination of parallax by photographing Mars when near the eastern horizon and again when near setting; the rotation of the earth, meantime, having carried the observer from one end to the other of a base-line whose length depends upon the latitude of the station and the time between the exposures. Precisely the same method was applid to the newly discovered asteroid Eros during the latter part of the year 1900. It is clear that the difference in place of the planet among the stars, when the eastward picture is compared with the westward, is due to parallax, allowance being made for the movements of the planet and the earth during the interval between the observations. A similar method may be used in investigations of stellar parallax, the photographs being taken at half-yearly intervals, thus securing a base-line nearly or quite equal to the diameter of the earth's orbit. Photographs of stellar spectra afford a means for detecting and measuring the motion of stars in the line of sight by noting the displacement of the lines toward either end of the spectrum. Through investigations of this sort it has come to be believed that there are many large, dark stars associated with visible stars, constituting, in some cases, systems of great complexity. The existence of such a dark body is inferred from the alternate approach and retreat of the visible star, relatively to the earth, this motion being apparently due to a revolution of the bright star about, or with, an invisible companion. In some cases, also, the periodic duplication of the spectral lines seems to indicate that a star is double, both components giving out light, while the largest telescopes fail to resolve the pair to the vision.

Photometry.— With a given time of exposure the size and blackness of the stellar images are proportioned to the brightness of the stars. This fact renders it easy to prepare lists of stars in order of brightness or "magnitude." The method is the less valuable, however, for the reason that the color of a star influences the chemical effect of its light upon the plate. A bright red star gives a smaller image in a given time than a fainter white or blue star. A complete photometric classification of the stars should be based upon measurements of the intensity of several portions of their spectra.

Transits, etc., by Photography.— By mechanical means it has been sought to eliminate the personal equation by photographing a star and the reticle of a transit or similar instrument at intervals automatically measured and recorded by clockwork. This must be taken as a very general statement of a method which, in a variety of forms, may yet be developed to a high degree of usefulness.

Instruments for Astronomical Photography. — It is well known that the lens of a visual telescope is quite unfit for photographic work. Those portions or components of white light that are best for seeing are not the components most effective in producing the negative. The blue and violet rays, left outstanding in the chromatic correction of the ordinary telescope, are precisely the ones wanted in photography, and they confuse and spoil the negative when the visual lens is tried as a photographic lens. Hence there must be a special objective for use in photographing, or an auxiliary lens for transforming the visual objective for its new work. So-called "portrait" lenses are much in use when a short focus, with large field and small images, is required. Lately much progress has been made in the use of mono-chromatic plates covered by colored glass screens, for absorbing the light that is not wanted. In this way it is possible to do good work in certain lines without a special lens. The accurate pointing of the telescope or camera is a matter of extreme difficulty, especially during long exposures. No driving clock yet produced, even when controlled, through electric devices, by the standard timepiece, is quite satisfactory. Therefore, it is necessary, in very many cases, that two telescopes, one visual and one photographic, should be bound together, and that an observer should keep the pair accurately pointed by hand. This is a most delicate operation, calling for great power of concentration, and for special deftness of touch. The observer, with eye at the visual telescope, keeps the cross-hairs of the eyepiece precisely upon a selected star. He watches and modifies the rate of the driving clock, moves the telescope as atmospheric refraction varies, and seeks in general to prevent all motion of the image on the plate. Upon the successful accomplishment of this difficult undertaking depends the final value of the photograph. In certain classes of work, however, the stars are allowed to "trail" a little, so that their images may readily be distinguished from specks and imperfections in the plate. The "coudé" telescope is much favored in Europe for photography, on account of the great steadiness of the eye-end and the comfort afforded the operator. In this country, when long-focus lenses are to be used, the tendency is toward the fixed horizontal telescope, a detached siderostat reflecting the light from the object into the telescope.

Among the more important adjuncts in instrumental devices should be mentioned the beautiful machines for measuring distances on the photographic negatives, this apparatus taking the place of the micrometer eyepieces used for direct measurements with the telescope.

F. S. LUTHER.

As'trocar'yum, a genus of about thirty species of tropical American pinnate-leaved palms noted for their profuse sharp spines sometimes a foot long. *A. murumuru,* the murumuru palm, a common species in the lower Amazon region, seldom attains a height of more than 20 feet. It bears an edible, melon-flavored, musky-scented ovate fruit about an inch long, the pulp of which is highly prized as food for man and cattle. Hogs crush the seeds, which are almost as hard as vegetable ivory, and fatten well upon them. *A. tecuma,* the tecuma palm, reaches a height of 30 to 40 feet, and has very regularly arranged spines, bears an edible, globular fruit, and is native of the same region as the preceding species. *A. vulgare* is a taller-growing palm than the above. The unexpanded leaves furnish a strong fibre, for which the tree is often cultivated where it is not native. To obtain this fibre the terminal bud is cut and the epidermis of the delicate leaves carefully peeled in ribbon-like strips that when dry are twisted into fine, strong durable threads used for making twine, bowstrings, hammocks, fish-nets, etc. The fibre of older leaves is coarser, tougher, and stronger, and is used for cordage; the petioles of the young leaves are used for making into baskets and hats. This species, commonly known as the tecum palm, is distinct from the tecuma palm noted above, but was confounded with it by Maritius, who pictured the tecuma as the fibre-bearing species. Consult: Wallace, 'Palm Trees of the Amazon' (1853). Several species are cultivated in greenhouses for ornamental purposes and specimens as large as 10 feet tall often bear fruit. For culture, consult: Bailey and Miller, 'Cyclopedia of American Horticulture' (1900–2).

As'trolabe (from Greek *astron*, a star, and *lambano,* I take), the name given by the Greeks to any circular instrument having one or more graduated circles. In modern astronomy this instrument is no longer used, because wholly superseded by the sextant. The first application of the astrolabe to navigation was made by the physicians, Roderich and Joseph and Martin Behaim of Nürnberg, when John II., king of Portugal, desired them to invent a method of preserving a certain course at sea. Angles of altitude were found by suspending the astrolabe perpendicularly.

Astrology, the science which pretends to foretell future events, especially the fate of men, from the position of the stars. Originally, that is, among the Greeks and Romans, the word had the meaning of «astronomy,» and, as in the case of alchemy and chemistry, the pseudo-science and the real science had the same origin. In early times, when the earth was regarded as the centre of the universe and as that to which all else was somehow tributary, it was a not unnatural hypothesis that the changing configurations of the heavenly bodies might be indicative of human destiny, or might influence human character. Hence, the Chinese, the Egyptians, the Chaldæans, the Romans, and most other ancient nations, with the honorable exception of the Greeks, became implicit believers in astrology. It was partly the cause and partly the effect of the prevalent worship of the heavenly bodies. The «star-gazers,» sarcastically referred to in Isa. xlvii. 13, were perhaps astrologers; so also may have been what are called in the margin «viewers of the heavens»; but the Hebrew word rendered «astrologers» in Dan. i. 20; ii. 2, 27; iv. 7; v. 7, is a much vaguer one, meaning those who practise incantations, without indicating what the character of these incantations may be. The later Jews, the Arabs, with other Mohammedan races, and the Christians in mediæval Europe were all great cultivators of astrology. Some of the greatest astronomers, among whom was John Kepler, who knew very much better, were accustomed to «cast horoscopes,» and to receive large fees for so doing. The ordinary method of procedure in the Middle Ages was to divide a globe or a planisphere into 12 portions by circles running from Pole to Pole, like those which now mark meridians of longitude. Each of the 12 spaces or intervals between these circles was called a «house» of heaven. The sun, the moon, and the stars all pass once in 24 hours through the portion of heavens represented by the 12 «houses.» Every house has one of the heavenly bodies ruling over it as its lord.

The houses symbolize different advantages or disadvantages. The first is the house of life; the second, of riches; the third, of brethren; the fourth, of parents; the fifth, of children; the sixth, of health; the seventh, of marriage; the eighth, of death; the ninth, of religion; the tenth, of dignities; the eleventh, of friends; and the twelfth, of enemies. The houses vary in strength, the first one, that containing the part of the heavens about to rise, being the most powerful of all; it is called the ascendant, while the point of the ecliptic just rising is termed the horoscope. The important matter was to ascertain what house and star was in the ascendant at the moment of a person's birth, from which it was deemed possible to augur his fortune. It followed that all people born in the same part of the world at the same time ought to have had the same future, an allegation which experience decisively contradicted. Even apart from this, astrological predictions of all kinds had a fatal tendency to pass away without being fulfilled; and when, finally, it was discovered that the earth was not the centre of the universe, but only a planet revolving around another body, and itself much exceeded in size by several of its compeers, every scientific mind in Europe felt itself unable any longer to believe in astrology, which has been in an increasingly languishing state since the middle of the 17th century. It still flourishes, however, in Asia and Africa, and is a means of livelihood to many charlatans who prey upon the ignorant classes in all countries.

As'tronom'ical and As'trophysi'cal Soci'ety of America, a national society whose members must possess technical knowledge of astronomical and astrophysical science. Membership (1903) 180.

Astronomy. Astronomy is that branch of science which treats of the heavenly bodies — including practically all the bodies of the universe. The great advance which our times have witnessed in the methods of research has made it one of the most progressive of the sciences, while it is, at the same time, the oldest of all. The vast extent of its field, including the entire universe within its bounds, leads to its having

a number of different branches. There is, first, a branch which embraces our general knowledge of the heavenly bodies, their motions, aspects, and physical constitution. This branch is commonly termed descriptive or general astronomy. It is now recognized as having two divisions, one relating principally to the motions, mutual relations, and general aspects of the heavenly bodies; the other to their physical constitution, considered individually. The former division is sometimes termed astrometry, because it is principally concerned with measurements of position, motion, mass, etc. The other branch is termed astrophysics, and is that which has received its greatest development in recent times. There is also a branch which teaches the methods of observing the heavenly bodies, including the instruments used in observation and measurement, and the principles governing their use, as well as the practical computations incident thereto. This branch is termed practical astronomy. Another branch is the mathematical one, which determines the orbits and motions of the heavenly bodies by deductive methods, taking as a basis the facts of observation and the laws of motion, especially that of gravitation. This branch treats of the orbits of the heavenly bodies and of the methods of computing the effects of their mutual attraction. It is commonly termed theoretical astronomy, while the more purely mathematical theory is known as celestial mechanics.

The subject of astronomy is treated in the present work on the following plan: We begin with a brief but comprehensive survey of the universe, referring to special articles — Stars, Universe, Nebulæ, Solar System, etc., for details. This survey will be followed by reviews of Practical Astronomy, Theoretical Astronomy, and of the historical development of the science.

Descriptive Astronomy.— Considered as to their nature, the heavenly bodies may be divided into two great classes; the one, incandescent bodies which shine by their own light; the other, opaque bodies which are visible only by reflecting the light of some incandescent body in their neighborhood. Examples of the first class are the stars which stud the heavens at night; examples of the second are the planets, of which our earth is one. From the very nature of the case, little can be learned of the possible number of opaque bodies which may exist in the universe. There may be some rather uncertain ground for inferring that they are less massive and less numerous than the incandescent bodies; but it is sometimes supposed that they may far outnumber the latter without our being aware of the fact. The stars are scattered through the wilderness of space at distances which baffle all our powers of conception. Light moves with such speed that it would make the circuit of the earth seven times in a single second. But the cases are rather exceptional when a star is so near one of its neighbors that light would not take years to travel over the distance which separates them. Indeed, the only known exceptions belong to the class of double or multiple stars — two or more such bodies forming a system by themselves. There is only one star so near us that its light would reach us in four years, and the same is probably true of most other stars. That the universe of stars extends to distances which light would require several thousand years to travel is certain; but no well-defined limit has yet been set to its extent. Our sun is one of the stars, and is the one of which we know most because of our proximity to it. It is the centre around which eight great planets and a number of other bodies perform their revolutions. On one of these great planets, the third in the order of distance, we dwell. Our knowledge of the heavens is largely conditioned by our residence on this planet. We see the other planets by the light of the sun, which they reflect. They present to the naked eye the appearance of stars; and it is only when scrutinized with the telescope that they are found to have a measurable apparent size. Vast indeed is their distance from the sun when measured by our standards. Yet, the dimensions of our solar system are very small when compared with the distance which separates the stars. Light passes from the sun to the outer planet, Neptune, in about four hours, while, as we have said, it requires years to reach any star. The nearest star is therefore thousands of times farther than the most distant planet. A most interesting question is whether other stars have systems of planets revolving round them, as our sun has. This is a question which it is impossible to answer conclusively. Planets revolving round the stars would be absolutely invisible through the most powerful telescope that man can ever hope to construct. In special cases, however, evidence on the subject is afforded by the spectroscope, which shows that great numbers of stars really have one or more dark bodies revolving around them. But, in order to be observable with the spectroscope, these bodies must be vastly larger than the planets which revolve round our sun. The existence of a planet like that on which we dwell could not be determined even with the best spectroscope.

The bodies of the solar system are bound together by the law of gravitation. Were it not for the attraction of the sun each planet would fly off in a straight line through space. Through the attraction of the sun all the planets are kept in their several orbits. Every consideration leads us to believe that gravitation extends from one star to all the others, but diminishing as the inverse square of the distance. But its effect on bodies so distant as the stars is too minute to be observed. Revolving double stars, however, show that in these exceptional cases, systems of two stars in proximity to each other are subject to the law of mutual attraction.

The three fundamental facts which determine the great phenomena of astronomy, as we observe them in the course of our lives are (1) the globular form of the earth on which we dwell; (2) its diurnal rotation on its axis; (3) its annual revolution round the sun. The first of these facts is so familiar to all that we need not discuss it. Out of it grow the general phenomena of the sky. The heavenly bodies surround us in every direction. They are really as numerous by day as by night, only in the former case they are blotted out by the brightness of the sky. To imagine the heavens as they really are we must fancy stars as always visible in every part of the sky. Then, by day, we should see the sun among the stars, and perhaps the moon also. Mere observation

of a heavenly body gives us no idea of its distance. By looking at a star we cannot tell whether its distance is to be measured by hundreds of miles, by millions, or by thousands of millions, which it actually is. Hence, all the heavenly bodies appear to us to be at the same distance, as if they were set upon the interior surface of a stupendous sphere in the centre of which we seem to be placed. This imaginary form is called the celestial sphere; it is one of the most ancient conceptions of astronomy, and it is used in the science to the present day to represent the appearance of the heavens. It is divided into two hemispheres, a visible and an invisible one. The visible hemisphere is the half which is above the horizon, which we call the sky and can always see, except so far as obstructions or inequalities of the ground may prevent. The other half is below the horizon, and is hidden from our view because the earth is opaque. Were the latter transparent, we should see the heavenly bodies in every possible direction. The revolution of the earth on its axis produces the phenomena of day and night, and the apparent rising and setting of the heavenly bodies. This is known as the diurnal motion. The latter may be considered in two aspects, either as the real revolution of the earth on its axis, in a direction always toward the East, or as an apparent revolution of the heavens in the opposite direction, due to our being unconscious of the motion of the earth. In consequence of the diurnal motion the celestial sphere, seeming to our eyes to carry the heavenly bodies on its interior surface, appears to us to make a daily revolution on its axis. The two opposite points of the celestial sphere situated on the prolongation of the earth's axis are called the celestial poles. On these poles as pivots the celestial sphere seems to turn. They are called north or south according to the direction. Their apparent position in the sky depends on the latitude of the place where the observer is situated. A heavenly body situated at either pole does not seem to have any diurnal motion. This is nearly the case with the pole star, which dwellers north of the equator can always see at an altitude above the northern horizon equal to their latitude. A voyager into the southern hemisphere sees the pole star set when he crosses the equator. Then, the south polar star would be visible if there were one. But it happens there is no bright star very near the southern prolongation of the axis. In the United States, say from 30° to 45° of latitude, the pole star is at a corresponding altitude above the horizon, and all the stars in its neighborhood appear to make a diurnal rotation round it, without changing their form or position, and without ever setting. Any one who chooses can verify this fact by noting the appearance of the northern sky about the end of twilight, and then looking at it again two or three hours later. He will then see that stars below the pole have moved toward the east; those on the east side of it have risen higher, and those on the west side are lower, while those above have moved over toward the west. For us, therefore, the sphere of the heavens may be divided into three parts; a circle round the north celestial pole within which stars never set; a corresponding circle round the south pole, the stars in which never rise above our horizon, and a broad middle region where they rise and set.

To represent the positions of the stars, astronomers imagine circles on the celestial sphere corresponding to the circles of longitude and latitude on the earth. As we imagine north and south meridians drawn on the earth from one pole to another, to measure terrestrial longitudes, so we imagine in the heavens circles drawn on the sphere from the north celestial pole to the south one. As the longitude of a place on the earth is expressed by the angle which its meridian makes with the meridian of Greenwich, so the corresponding quantity for a star is the angle which the circle through it makes with a certain prime meridian on the celestial sphere. This quantity for the stars is not called longitude, but *right ascension,* and the celestial meridians which determine it may be called *hour circles.*

In the same way as we have on the earth a great circle spanning it, everywhere equally distant from the two poles, and called the equator, so we imagine a circle spanning the heavens, everywhere equally distant from the north and south celestial poles, which is called the celestial equator, or the equinoctial. At any one place this circle will be apparently fixed in its position, always intersecting the horizon at its east and west points, and, in our latitudes, intersecting the meridian south of the zenith by a distance equal to our distance from the equator. For example, to a dweller in latitude 40°, the highest point of the celestial equator will be 40° from the zenith, and 50° above the horizon. From this point it spreads toward the east and west until it intersects the horizon as just stated. As a traveler journeys south, the position of the celestial equator becomes more and more nearly vertical; at the equator it rises vertically and passes through the zenith; south of the equator it passes north of the zenith.

As the latitude of a place is measured by its angular distance from the equator north or south, so the corresponding number for a star is measured by its mean angular distance from the celestial equator, whether north or south. This is called the star's *declination.* Thus the right ascension and declination of a star determines its position on the celestial sphere just as longitude and latitude determine the position of a city on the earth.

We now have to consider the effect of the annual motion of the earth round the sun. If we watch the heavens at a certain hour every evening, say eight o'clock P.M., we shall find that the stars are every night a little farther advanced in their diurnal motion then they were the night before. If they are in a certain position at eight o'clock on one evening, they will pass the same position four minutes before eight on the next night, eight minutes before eight on the next night, and so on. In the course of a year these continually accumulating changes make up the whole 24 hours, so that a star which is in the zenith this evening will be on the meridian at eight o'clock in the morning six months hence, while at eight in the evening it will be at its greatest distance below the horizon. If we could see the sun among the stars, what we should notice would be that our luminary always forges a little

farther east day after day, and in the course of a year seems to make a complete revolution among the stars. The result is that while the sun rises and sets 365 times, the stars rise and set 366 times. Since the latter are always in the same absolute direction, and seem to rise and set in consequence of the earth's rotation on its axis, we infer that the direction of the sun from the earth goes through a complete revolution in the course of a year. In other words, the sun appears to us to make an annual revolution around the celestial sphere among the stars. Since the time of Copernicus it has been known that this appearance is due to the actual revolution of the earth around the sun.

The apparent path of the sun among the stars can be mapped out by astronomical observation. When carefully observed, it is found to be a great circle of the sphere, called the ecliptic. We thus have two imaginary circles of fundamental importance spanning the heavens. One is the celestial equator, the other the ecliptic in which the sun seems to travel. These circles do not coincide, but intersect each other at two opposite points at an angle of 23½°. This is called the *obliquity of the ecliptic*. The result of it is that during one half the year the sun is south of the celestial equator, and during the other half is north of it. In the northern half of its course we have summer in the northern hemisphere and winter in the southern; in the southern half we have summer in the southern hemisphere and winter in the northern. Thus the changing seasons are due to the obliquity of the ecliptic. If the latter coincided with the equator, we should have no such annual round of seasons as that with which we are familiar.

There are two opposite points on the celestial sphere at which the equator and the ecliptic intersect. These are called *equinoxes* because, when the sun crosses them, the days and nights are equal all over the earth. That equinox which the sun passes toward the north is called the vernal equinox, because the crossing marks spring in the northern hemisphere. The other is called the autumnal equinox for a similar reason. Observations continued through many centuries show that the equinoxes are not fixed, but travel slowly along the ecliptic at such a rate that they make a complete revolution from the east toward the west in about 26,000 years. This motion is called the precession of the equinoxes. Its existence shows that the direction of the earth's axis is slowly changing, and hence the position of the celestial pole is changing also. Since the equator is defined by the condition that it spans the heavens midway between the celestial poles, this change in the poles causes a corresponding change in the equator.

The actual motion of the pole is at the rate of about 20″ per year. The smallest visible object that can be seen to be anything else than a point of light subtends an angle of about 1′ or 60″. It follows that the pole moves through this smallest visible space in three years. In a long life of 90 years the change would be about equal to the diameter of the sun or moon. The centre of the motion is the pole of the ecliptic which is distant from that of the equator by about 23½°. Owing to the smallness of the obliquity, the equinox travels along the ecliptic at more than twice the rate of the pole, or about 50″ per year. It has therefore changed about 30° since its motion was first noticed, about 2,000 years ago. It is found that the planets describe their course around the sphere in circles which do not deviate greatly from the ecliptic. A belt of the heavens extending 11° on each side of the ecliptic will include all the planets visible to the naked eye. This belt is called the zodiac. Beginning at the vernal equinox it is divided into 12 portions, of 30° each, known as the signs of the zodiac. In former times great stress was laid upon the entrance of the sun into these several signs, which entrances occurred about a month apart. They now occur about the 20th of every month. In our times, when the superstitions connected with this subject have vanished, the entrance of the sun into the signs is no longer of importance. (See ZODIAC.) There are also 12 constellations, beginning with Aries, and ending with Pisces, which have the same names as the signs of the zodiac, and are scattered along its course. Two thousand years ago these constellations coincided pretty closely with the signs. But now, in consequence of the precession of the equinoxes, the two no longer correspond. The sign Aries is now located in the constellation Pisces; the sign Taurus in the constellation Aries, etc.

The Time of Day.— It is in its relations to times and seasons that the results of astronomical science come into every household. Our daily round of activity and rest is determined by the earth's rotation on its axis, alternatingly bringing us under the sun, and then carrying us around until it is hidden from our sight. A century ago people used to set their clocks at 12 when the sun crossed the meridian. This moment, being the middle of the day, is noon properly so-called. But if a good clock is exactly regulated, and kept going all the time, it will not show noon at the true time. The reason is that the intervals of time between one noon and the next are not exactly the same. See TIME.

Bibliography.— The most extended general treatise on astronomy for the use of the general reader is 'Chambers' Astronomy' (3 vols., 8 vo., London); briefer is Newcomb's 'Astronomy for Everybody'; Ball, 'Story of the Heavens'; Flammarion, 'Popular Astronomy'; etc.

SIMON NEWCOMB, LL.D.,
Washington, D. C.

Astronomy, History of. We may recognize four great periods in the history of astronomical knowledge. The first and most ancient is that in which no accurate observations were made, but in which men had a general knowledge of the apparent annual revolution of the sun, of the constellations, and of the relation of the sun's annual course to the changes of the seasons. The next period was that of the celebrated Alexandrian school, so-called because Alexandria was the principal seat of its activity. This period was distinguished as that at which the first attempts were made at precise observation and measurement. It began three or four centuries before Christ. It is very remarkable that, at so early a period as this, men to whom all our modern science was completely unknown, had so far advanced in astronomical observation as to measure the obliquity of the ecliptic, determine the times of the equinoxes, and detect their precession. The latter was done by a comparison of two meth-

ods of determining the length of the year, as measured by the sun's apparent revolution around the celestial sphere. Timocharis, who flourished about 300 B.C., determined the moment at which the sun crossed the equinox by means of an east and west line on the level sandy plains of Egypt, showing exactly where the sun rose or set. The day on which the point of settting in the west was exactly opposite that of its rising in the east marked the equinox, which could thus be determined within a few hours. The annual course of the sun can also be determined by the time which it takes to return to the same position among the stars after an annual apparent revolution. As the stars and sun cannot be seen at the same time, the adopted plan was to measure the distance of the sun from the moon before sunset, and after dark to measure the distance from the moon to some bright star. Allowing for the motion of the moon during the interval, the distance of the sun from the star would be known. In this way the curious discovery was made that the year as determined from the equinoxes was several minutes shorter than that determined from the stars. This discovery was made by Hipparchus through a comparison of his observations with those of Timocharis about 150 years before.

Erastothenes, who flourished just before Timocharis, was enabled to estimate the size of the earth. This he did by noting that at the ancient town of Syene, in central Egypt, the sun was exactly in the zenith at the time of the summer solstice, so that it illuminated the bottom of a well, while at Alexandria it was 1/50 of a circumference south of the zenith. He therefore concluded that the circumference of the earth was 50 times the distance between Alexandria and Syene. The latter being 50,000 stadia, it followed that the circumference of the earth was 250,000 stadia.

Hipparchus was considered as the greatest astronomer of antiquity. He made more accurate observations than any of his predecessors upon the courses of the sun, moon, and planets, determining their times of revolution with extraordinary exactness. Unfortunately none of his works survive, and our knowledge of them is derived mainly from Ptolemy's 'Almagest.'

Ptolemaic System.—Ptolemy (130–150 A.D.), besides being a practical astronomer, was accomplished as a musician, a geographer, and a mathematician. His most important discovery in astronomy was the evection of the moon. He also was the first to point out the effect of refraction. He was the founder of the false system known by his name, and which was universally accepted as the true theory of the universe until the researches of Copernicus exploded it. The Ptolemaic system placed the earth, immovable, in the centre of the universe, making the entire heavens revolve round it in the course of 24 hours. The work by which he is best known, however, is the collection and systematic arrangement of the ancient observations in his great work, the 'Megale Syntaxis,' which gives a complete *résumé* of the astronomical knowledge of the day. This work was translated into Arabic in the first part of the 9th century and was called by the Arabs the «Almagest,» and by this name it is known today in its various translations into Greek and Latin. The most important part of it is the seventh and eighth books, which contain the catalogue of stars which bears Ptolemy's name, though it is only a compilation of the catalogue of Hipparchus with the positions brought up to the time of Ptolemy. The advance of astronomy almost ceased, after the death of Ptolemy, and his 'Almagest,' together with the false system of the universe which it taught, continued to be the recognized authority in Europe for the next 14 centuries.

With the death of Ptolemy, everything in the way of actual progress in astronomical theory appeared to cease. The Arabians continued astronomical observations from time to time, and made or proposed many improvements in the ancient astronomical instruments, but they slavishly followed the system of Ptolemy, and made no attempts to penetrate the mystery of the celestial motions. They had little capacity for speculation, and throughout held the Greek theories in superstitious reverence. The most illustrious of the Arabian school were Albategnus, or Al Batani (880 A.D.), who discovered the motion of the solar apogee, and who was also the first to make use of sines and versed sines instead of chords; and Ibn-Junis (1000 A.D.), an excellent mathematician, who made observations of great importance on eclipses of the sun and moon and the motions of Jupiter and Saturn, and who was the first to use cotangents and secants. Likewise, at about the same time, Abul Wefa discovered the third inequality in the moon's motion, the variation, and determined its amount. About four centuries later, in the first half of the 15th century, lived Ulugh Beigh, a Tartar prince, who made important additions to astronomical knowledge.

The third period commenced when Copernicus, in 1543, first demonstrated the true theory of the universe to his fellow men in his great work 'De Revolutionibus Orbium Cœlestium,' His two fundamental principles were that, instead of the diurnal motion of the heavens being real, it was only apparent, being due to the revolution of the earth on its own axis; and that the apparent revolution of the sun around the sky was, in the same way, due to the actual revolution of the earth around the sun, which latter remained at rest. Centuries of observation have shown that these two principles explain so exactly every detail of celestial phenomena that they are subject to no more doubt than our conclusions as to the arrangement of streets and houses in a city which we see every day of our lives. Half a century after the death of Copernicus flourished Galileo and Kepler, of whom the first invented the telescope, while the second demonstrated the correctness of the Copernican theory, and also showed that the planet Mars revolved around the sun in an ellipse with the sun in its focus.

The invention of the telescope added another proof to the Copernican theory, and also enlarged our views of the universe by showing that Jupiter and his satellites formed a miniature solar system on the Copernican plan; that the planet Venus had phases like the moon; that the moon itself had a variegated surface apparently similar to that of our globe, and that the wonderful Milky Way was composed of innumerable stars too faint to be seen sep-

arately by the naked eye. The spots on the sun were also discovered, and the rotation of our central luminary on its axis made known. Such enormous advances were too great for the human mind at once to grasp, and the generation in which Galileo lived had to pass away before the Copernican theory was universally accepted by the learned world. To this same period belong the observations of Tycho Brahe on the motions of the sun, moon, and planets, which were, most unfortunately, made just before the invention of the telescope, and so failed of the precision which would have been gained by the use of that instrument. But, as it was, they were the basis on which Kepler founded his celebrated laws of planetary motion.

The fourth and last period began when Newton showed that all the complicated phenomena of the celestial motions — the revolution of the planets in elliptic orbits, and the revolution of the satellites around their primaries, were all due to the mutual gravitation of these bodies, and took place according to the same laws which govern the motion of matter around us on the earth. As in the case of the Copernican theory, it took the learned world a whole generation to grasp the idea of Newton as to the theory of gravitation. The progress made in our knowledge of the celestial motions during the two centuries since Newton's time have all rested on the principle which he discovered.

Toward the end of the 18th century, Sir William Herschel, then in the zenith of his fame, was interesting the whole world by his wonderful discoveries. With his great reflectors he made a step forward in the size and power of the telescope greater than any before or since. Although his greatest and best instrument would be considered extremely imperfect at the present time, those which it superseded were hardly more than what we should now call spy glasses. Herschel was so far the greatest figure of the time in astronomical science, and his work so overshadowed that of his contemporaries on the continent, that the work of everyone else at the time seems unimportant in comparison. Yet not only were great successors of Herschel coming on the stage, but important additions to our knowledge of the heavens were being made outside of England. William Herschel's son, John, was a lad of eight years. In France, Arago, a boy of 14, was fitting himself for the École Polytechnique. At Paris, Lalande, the leading astronomer of France, was actively preparing a catalogue of the fainter stars with an instrument which would now be consigned to the junkshop. But it was the first attempt that had ever been made to determine accurately the positions of the many thousand telescopic stars invisible to the naked eye, and in consequence the 'Histoire Céleste' is still one of the classics of the astronomical investigator. In Germany, Olbers combined the professions of physician and astronomer, and Bessel, a youth of 16, was clerk in a mercantile house.

The first day of the century was marked by a discovery of capital interest and importance. The wide gap between the planets Mars and Jupiter had been a source of wonder, and the conviction that there must be a planet in it had become so strong that an association of astronomers was formed to search for it. But, on 1 Jan. 1801, before they got to work, Piazzi, the Italian astronomer of Palermo, found Ceres. The year following Olbers discovered Pallas, and propounded his celebrated theory that the newly formed bodies were fragments of a shattered planet, more of which might be found. This anticipation was amply justified by the result, though the theory of a shattered planet has long been rejected. By 1868 the number reached 100. When the sky was systematically watched 100 more were found. When the process of photographing the stars was perfected, so many new ones were found on the photographic plates that it is almost impossible to follow them up. About 450 have had their orbits mapped out. See ASTEROIDS.

In this country, David Rittenhouse, almost the only American of Revolutionary times who has a place in scientific history, had been dead four years when the century began, and there was no one to take his place. He was one of the committee of the American Philosophical Society that made an extensive and well-planned set of observations on the transit of Venus in 1769. The first American after the Revolution to acquire eminence in any department of astronomical science was Nathaniel Bowditch. A Boston ship-captain by profession, he first prepared his 'Navigator,' the standard work of the sailor through most of the century. He mastered the great work of Laplace, and made it accessible to students by a translation and commentary explaining the processes in detail. So far as practical astronomy was concerned, it might be regarded as non-existent among us during at least the first third of the century. We know little more of it than that Robert Treat Paine, grandson of the signer of the Declaration of Independence, used to compute eclipses and publish the results in the 'American Almanac,' and the Boston *Advertiser*. About 1840, Dr. Lardner paid a visit to this country and remained several years, delivering public lectures, which, though not of a high order when measured by the standard of to-day, were much above any which Americans had then heard.

During the first half of the century, the advance of astronomical science consisted principally in a form of development which goes on without any striking discovery, and has therefore little interest for the general public. When bright comets appeared they were carefully studied by observers, at the head of whom were Bessel and Olbers. It was thus found that the tail of a comet was not an appendage carried along with it, like the tail of an animal, but merely a stream of vapor arising from it and repelled by a force residing in the sun. The discovery of telescopic comets by observers, here and there, continually added to the number of these bodies known. Most of them were found to be moving in such orbits that they would require thousands of years, perhaps tens of thousands, to return to the sun, if, indeed, they ever reappeared. But this, though the general rule, is far from being universal. From time to time comets were found moving in closed orbits and performing their revolution in periods of a few years, mostly between 3 years and 10.

One of the noteworthy discoveries of the third quarter of the century was that of the

relation between comets and shooting stars. The first discovery of this relation came about in a curious way. The researches of H. A. Newton and others had made it quite clear that shooting stars were due to the impact of countless minute bodies revolving around the sun in various orbits and now and then encountering our atmosphere. It was also known that the great November meteoric showers must be due to a stream of such bodies. One astronomer computed the orbit of the November meteors; and another quite independently published the orbit of a comet which appeared in 1866. A third astronomer, Schiaparelli, noticed that the two orbits were practically the same. The conclusion was obvious. The minute bodies which caused the shower moved in the path of the comet and were portions of its substance which had from time to time separated from it. The disappointing failure of the shower in 1899 and 1900 can have but one cause — a small change in the orbit of the meteoric swarm caused by the attraction of the planets. Nor has the comet associated with them shown itself; it was perhaps dissipated like that of Biela's. Apart from this, the question of the constitution of comets is still an unsolved mystery. Their spectrum is that of a body which shines by its own light. But no one can explain how a body in the cold and vacuous celestial spaces can so shine. The brighter comets may have a more or less massive nucleus. Yet it is not certain that the nucleus is entirely opaque. In 1882, the astronomers at the Cape of Good Hope enjoyed an opportunity which no one of their brethren ever enjoyed before or since; that of seeing a comet enter on the disk of the sun. Unfortunately, the sun disappeared from view a very few minutes afterward. But not a trace of the comet could be seen on the sun as a spot. It was seemingly quite transparent to the solar rays. That the fainter comets have no nucleus and are merely composed of a collection of foggy particles seems certain. How are these particles kept together through so many revotions? This question has not yet been satisfactorily answered. See Comet.

The Greenwich Observatory was taken in charge by Airy in 1834. He immediately instituted a great improvement in its organization and work, but it was not till 1850 that he acquired for it new instruments of great importance. He was the founder of what has sometimes been called the Greenwich system: the astronomers of an institution taking a part like those of soldiers in an army, making all their observations on a plan prescribed by the authority and rarely using their own discretion in any way. The mathematical theory of the motions of the planets, and especially the moon, received its greatest improvement from the hands of Hensen, born about 1795. He may fairly rank as the greatest of celestial mechanicians since the time of Laplace. Toward the middle of the century, he prepared the first tables of the moon which could satisfy the requirements of modern astronomic theory. These were published by the British government in 1857, and have now formed the basis of astronomical ephemerides for nearly half a century. The most striking event of the mid-century period, and one which in the popular mind must long hold its place as among the greatest of intellectual achievements, was the computation by Leverrier of the position of an unknown planet from its attraction on Uranus. The speedy discovery of the planet on the very night it was first looked for was, for the public, a proof of the absolute correctness of gravitational theories that surpassed all others. It was as a first and bold attempt to sail into an unknown sea; yet, as in the case of Columbus and the Atlantic, its repetition would not now be generally considered a difficult matter. With the discovery of Neptune and with the advance in the art of astronomical observation, improvements in the theories of the movements of the planets were necessary. The greatest step forward in this direction was taken by Leverrier. Among the results of his work was the discovery that the perihelion of Mercury moves more rapidly than it should under the influence of gravitation. This excess of movement has been abundantly proved by observation since his time, but its cause is still one of the greatest mysteries of gravitational astronomy. As a general rule, it may be said that during the last half century the Germans have been the leaders in astronomical research. Their work on the subject has been more voluminous than that of any other nation. The leading astronomical journal of the world is still that of Germany. But when we consider not quantity of work, but the special importance of particular works, precedence has, from one point of view, passed to America. While, perhaps, we still have fewer students pursuing astronomy in the United States than in Germany, the number of men among us who have acquired the highest distinction and most skilfully made applications of this science is greater than in any other country. The rapidity of progress from small beginnings is very remarkable.

In 1832, Professor Airy delivered, before the British Association for the Advancement of Science, an address on the progress of astronomy, which soon acquired celebrity. The state of astronomy in different countries was reviewed. America was dismissed with the remark that he was not aware of any observatory existing in that country. In the revival of astronomy among us and its advance to its present position in popular favor, one agency has not been esteemed so highly as it deserves. Contemporaneous with the visit of Dr. Lardner were the lectures of Prof. Ormsby M. Mitchel. With unsurpassed eloquence he explained the wonders of astronomy to audiences intensely interested in the novelties of the subject. From a scientific point of view the lectures were probably not of a high order, nor could it be said that Mitchel himself, active and enthusiastic though he was, was a profound astronomer. Yet it may well be said that to him is due the ability of our astronomers since that time to secure the public support necessary to the erection of the fabric of their science. A few years after Airy's address small college observatories were founded at Williams College and at the Western Reserve College, Ohio. These were doubtless a stimulus to students, but can hardly have added to astronomical science. When the Wilkes Exploring Expedition was being organized, it was found necessary to have a continuous series of observations made at home during the absence of the expedition which, compared with those made on the ships, would en-

able the navigators to determine the longitudes of the lands they discovered. A little wooden structure, erected by Captain Gilliss for this purpose, on Capitol Hill, Washington city, was in some sort the beginning of our National Observatory. The actual foundation of the latter was almost contemporaneous with that of the Harvard Observatory, both being commenced about the year 1843. The Harvard Observatory was placed under the direction of William C. Bond, who had, for many years, made observations, first at his own house in Dorchester, and then on top of a house at Cambridge. At Washington the Naval Observatory was placed under the charge of Lieut. Maury. After getting its instruments in operation, he devoted himself almost entirely to those researches on ocean currents, which, so long as the commerce of the world was carried on mostly in sailing vessels, were of the first importance. But the institution soon acquired astronomical celebrity in other ways. Here Sears Cook Walker made the first thorough investigation of the orbit of Leverrier's newly discovered planet, and showed that it had been twice observed by Lalande as far back as 1795, but without its character being suspected. Here also the device of recording the transits of stars by means of the chronograph and determining the longitude of places by telegraph found their first application. New observatories, some founded in connection with colleges, others by private individuals, now sprang up rapidly among us in every quarter. Twenty-four were enumerated by Loomis in 1856. What figure the number has now reached it is impossible to say. Whatever it may be, it marks rather the interest taken by the intelligent public in astronomical science than the actual progress of knowledge. The number of these institutions which have actually made important contributions to astronomical knowledge is naturally very small. It is to a few leading ones that most of the progress is due.

Two of these have put almost a new face upon astronomical science. These are the Harvard Observatory at Cambridge and the Lick Observatory of California. The former, while a respectable institution from its foundation, and made famous by the works of the Bonds, had never commanded the means necessary to prosecute astronomical research on a large scale. When Pickering assumed the directorship in 1875, he devoted his energies to those branches of research which are now known under the general term of astro-physics, being concerned with the physical constitutions of the heavenly bodies rather than with their motions. The extension of his work was made possible by very large additions to the endowment of the observatory. It thus became one of the best-supported institutions of the kind in the world. Photometry and spectroscopy have been its main subjects. With the aid of a branch established in Arequipa, Peru, the magnitudes of all the stars in the heavens visible to the naked eyes, as well as many fainter ones, have been determined. Among its remarkable discoveries have been those of new stars. It was formerly known that at long intervals, sometimes more than a century, sometimes less, stars apparently new blazed out in the sky. Really the star was not new, but was an old and very small one of which the light was temporarily multiplied hundreds of thousands of times. A system of constantly photographing the heavens showed that such objects appear every few years, only they do not generally attain such brilliancy as to be noticed by the unassisted eye. The success of the Lick Observatory in a different, yet not wholly dissimilar, direction must be regarded as one of the most extraordinary developments of our time. Commencing work about the beginning of 1888, under the direction of Holden, and supplied with the greatest telescope that human art had then produced, the observations of Burnham and Barnard excited universal interest, both among astronomers and the public. The discovery of a fifth satellite of Jupiter, perhaps the most difficult object in the heavens, was made there by Barnard in 1892. Later, the optical discovery of the companion of Procyon, an object known to exist from its attraction on that star, was made by Schaeberle. But its most epoch-making work is due in still more recent years to Campbell, by measurements of the motion of stars in the line of sight with the spectroscope. The possibility of measuring such motions was first demonstrated by Huggins, some thirty years ago, and was applied both by him and by the observers at Greenwich. Then a great step forward was made by photographing the spectrum instead of depending on visible observation. This step was mostly developed by Vogel, at the Potsdam Observatory, near Berlin. In the case of the variable star, Algol, Vogel was thus enabled to show that the fading away of its light at regular intervals of something less than three days was really a partial eclipse of the star by a dark body revolving around it. He also showed that three other bright stars varied in their motions to and from the earth in a way that could arise only from the revolution of massive but invisible bodies around them. Now, at the Lick Observatory, Campbell, armed with the best spectrograph that human art could make, the gift of D. O. Mills, has, by the introduction of every refinement of his method, brought into these measures a degree of precision never before reached. The cases of variable motion, as found by him, are so numerous as to indicate that isolated stars may be the exception rather than the rule. It is true that up to the present time he detects variation in only about one star out of thirteen which he observes. But it is only in the exceptional cases, where the planet is almost as massive as the star itself, that the motion can be detected. It is not at all unlikely that, for every spectroscopic binary system (as these pairs of objects are now called) we can detect, quite a number may exist in which the revolving planet is too small to affect the motion of the star. With the beginning of a new century, astronomy, the oldest of the sciences, seems to be entering upon a new career, with a prospect of a life before it the end of which no man can foresee.

Bibliography.—In French, we have the monumental works of Delambre; in English, Agnes M. Clerke., 'History of Astronomy in the 19th Century'; Berry, 'History of Astronomy.'

SIMON NEWCOMB, LL.D.,
Washington, D. C.

Astronomy, Practical. The instruments of observation used by the working astronomer are made up mainly of various combinations

of three appliances. These are the telescope, the graduated circle, and the clock. (For the principles of the first see TELESCOPE.) With the clock is associated the chronograph as part of a combination for measuring time. Many auxiliary appliances are also brought into use of which the micrometer and the spirit level are the most important. The usefulness of the telescope in measurement does not arise solely from its enabling the observer to see objects

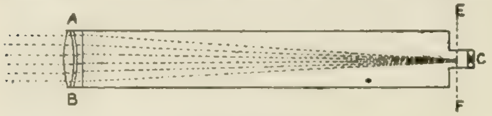


FIG. 1.

otherwise invisible. A telescope with no magnifying power at all would still enable him to determine the directions of the heavenly bodies at any moment with greater accuracy than would otherwise be attainable. The principle on which the telescope is used in celestial measurement will first be explained. Let Fig. 1 represent the section of a telescope; A B being the object glass, and C the eye-end, where the rays from a star are brought to a focus. The lines converging to the plane E F represent the rays of light from a star reaching the focus. Here they form an image of the star, which the observer sees by looking into the eye-piece at C. The plane, of which the dotted line E F is a section, passing through the focus at right angles to the telescope, is called the focal plane. By changing slightly the direction in which the telescope is pointed, the rays may come to a focus on any point in this plane not too far from the axis or central line of the telescope. In the focal plane is placed a system of very fine threads which the observer sees when he looks into the eye-piece. These threads are generally made of fibres of spider-web, a substance so well adapted to this purpose that nothing better has yet come into use. To fix the ideas we shall suppose several cross threads; then the observer by looking into the telescope may see the stars and the

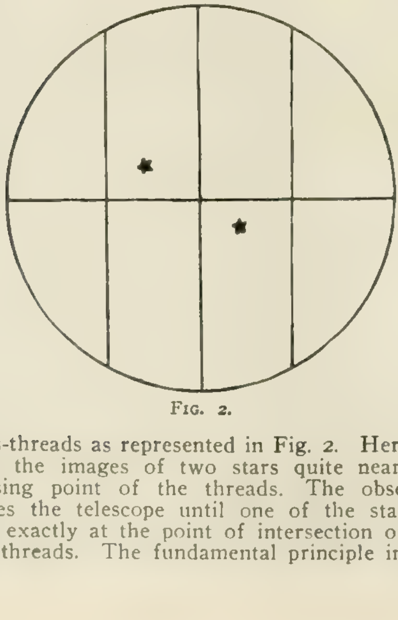


FIG. 2.

cross-threads as represented in Fig. 2. Here we have the images of two stars quite near the crossing point of the threads. The observer moves the telescope until one of the stars is seen exactly at the point of intersection of the two threads. The fundamental principle in the use of the telescope is that when this occurs, the star is apparently situated exactly on a straight line passing through the cross threads, and the centre of the object glass. This line is called the line of sight of the telescope.

Now, let the observer move the telescope until he finds another star, whose image he brings upon the cross threads. The angle through which he has moved the telescope from one star to the other, supposing the two stars to be at rest, will then be precisely the angle between the rays of light coming from the two stars. If, then, any system is adopted of determining through how many degrees, minutes,

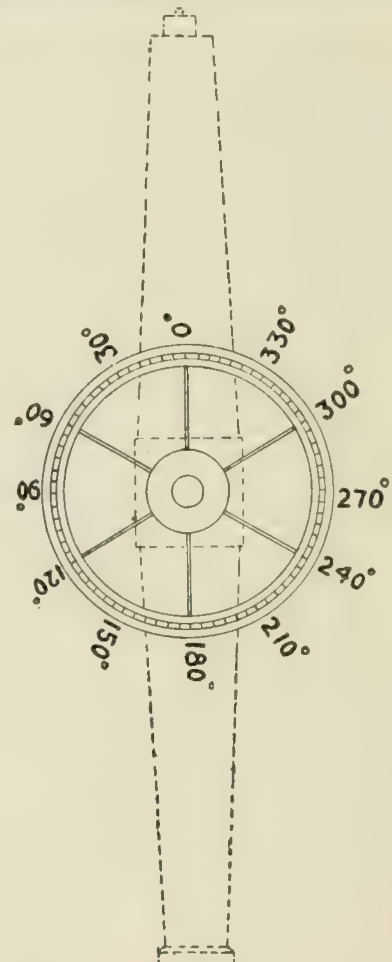


FIG. 3.

etc., the telescope has moved, the angular distance between the stars is known. The studious reader will remark that, owing to the rotation of the earth, the image of a star seen in a fixed telescope is continually moving across the field of view. To explain the principle we must, however, leave this motion out of account, or suppose it allowed for.

We have next to show how a large angle through which the telescope may be moved is measured. This is done by means of the graduated circle, a representation of which is shown in Fig. 3. It will be seen that the rim of the

circle is divided up into degrees by fine lines as represented in the figure, where, however, only every fifth degree is marked. In the instruments actually used in astronomy, not only is every degree marked, but in the circles for the finest observations, the degrees are still farther sub-divided into spaces of 5′, 3′, or even 2′. Since there are 360° in a circumference, it follows that in a division to 2′ there will be 10,800 of these graduations, or fine marks, on the circle. These marks must all be as nearly equi-distant as human art can make them, and the problem of doing this, together with that of making them so fine and sharp that they

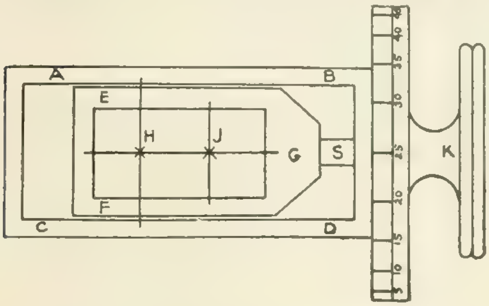


FIG. 4.

can be used in the most precise measurement, is one of the most difficult with which the instrument maker has to deal. The way in which the divided circle is used to measure the angular motion of the telescope is shown by the dotted outline of the latter. The circle is attached to it so that both move on an axis concentric with the circle and perpendicular to its plane. Then, when the telescope is turned on this axis, the circle turns with it as a grindstone does on its axis. The distance through which telescope and circle are turned is then measured by means of the graduations. To show how this is done, other appliances must be described.

Instead of two stars being far apart, so that the telescope has to be moved, they may be alongside of each other, as in Fig. 2; then, the observer, by moving the cross-threads from one star to the other, and measuring the amount of the motion, can determine the angular distance between the stars, and their relation to each other. This is done by a micrometer, one kind of which will now be described.

The Filar Micrometer.— This adjunct is so called because an essential part of it consists in fine threads of spider lines stretched across the field of view, as already described. The aim of its construction is to admit of these threads being moved in a direction at right angles to their length, by a very fine screw, so that the space over which they pass may be measured by the turns of the screw. The principal appliances for effecting this are a fixed frame, A B C D, Fig. 4, in which slides another frame, E F G, moved by a fine screw at S. Across this inner frame is stretched the spider line J, and across the fixed one the spider line H. To the head of the screw is attached a cylindrical rim, which has 100 or some other number of divisions cut upon it. An index mark serves to show how far the screw is turned. An apparatus for measuring the number of turns of the screw is attached, but need not be described here. Then when the observer turns the screw, the movable frame of the spider lines is slowly carried along with it. The position of the spider lines as they move is then shown at every moment by the number of turns of the screw and the fractions of a turn. To show the accuracy with which this can be done, we remark that the screws used by astronomers may have 100 or even 125 turns to the inch. Then, each revolution of the screw, as read off on the head, measures to a motion through this space. There being 100 graduations on the head, each graduation may measure the motion of 1-10,000 of an inch. But the observer may estimate the tenths between the divisions, thus carrying his measurements down to the 1-100,000 of an inch. Beside the movable spider line across the frame, fixed spider lines may also be stretched across the fixed frame. Then we shall have two systems of spider lines, one movable and the other fixed. The relation of each to the other is measured by the turns of the screw.

To determine the exact position of the graduated circle, a filar micrometer O is attached to a microscope of the form shown in Fig. 5, and the latter is finally fastened to a fixed frame in such a position that, when the observer looks into the microscope, he sees the graduations on the circle magnified as many times as necessary, and also the threads of the micrometer. The microscope being fixed remains at rest while the circle turns. If the instrument were geometrically perfect in every respect, one reading microscope would answer

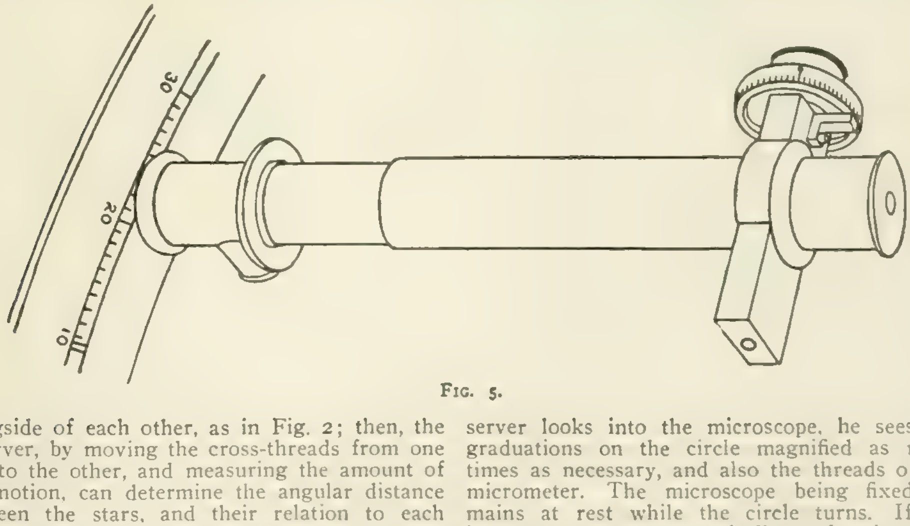


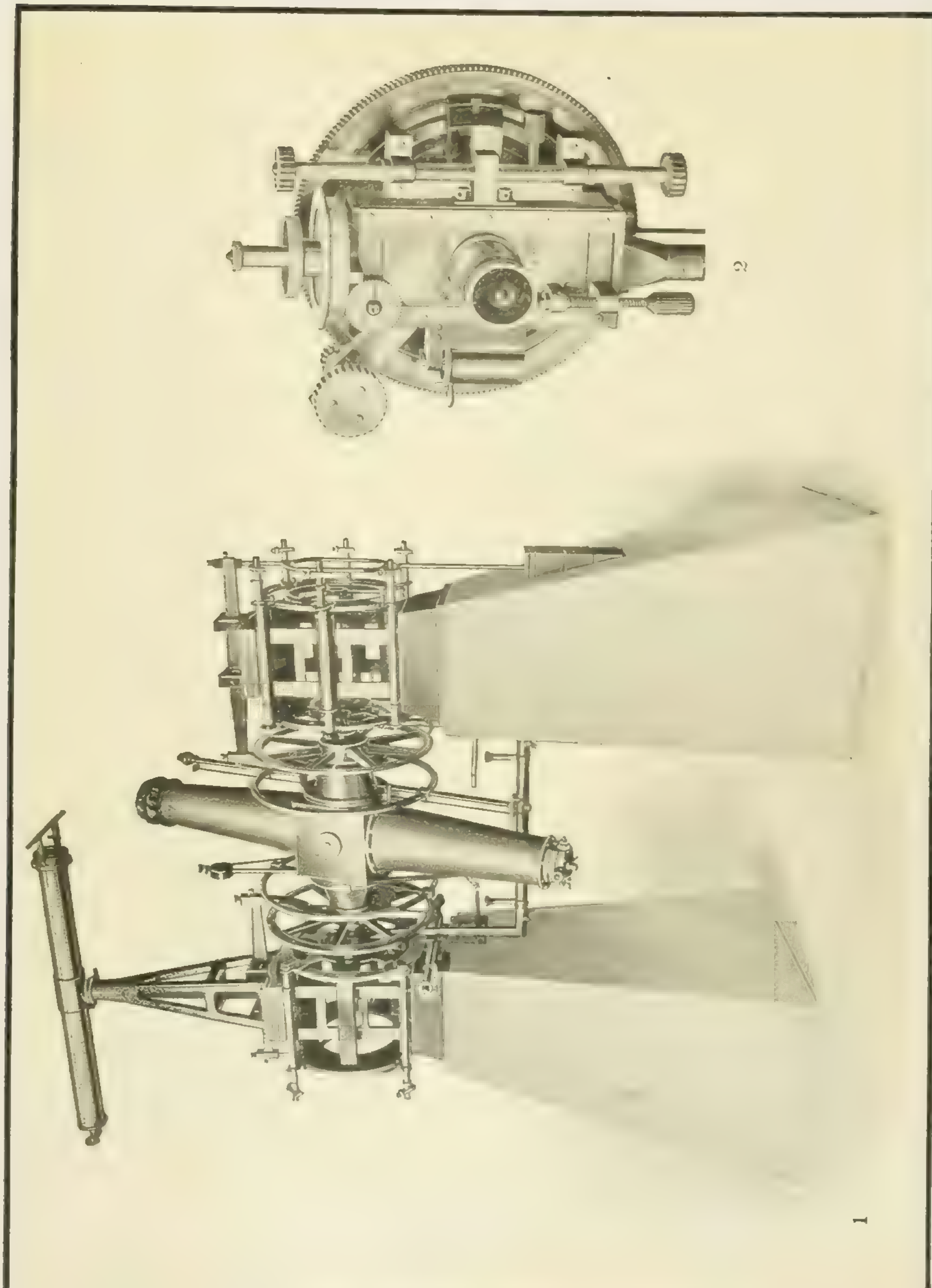
FIG. 5.

the purpose; but, as the circle cannot be centred with mathematical exactness, pairs of microscopes are used which are at opposite ends of diameters of the circle. For example, when the graduation 15° 20′ is brought under one microscope, the graduation 195° 15′ would be under the opposite one. It is customary, for greater precision, to have two such pairs at right angles to each other, or four microscopes in all.

To determine the position of the circle, and hence the direction in which the telescope attached to it points, the observer looks into one of the microscopes and fixes upon some graduation of the circle, turns the micrometer screw till a spider line, or the middle of a pair of lines is central on the graduation, and then reads the indication of the head of the screw. It will be noticed that in Fig. 5 the mark 21° is central under the microscope. By pointing his telescope on one star after another and reading the microscope in this way, noting on each occasion what graduation is read, the distance through which the telescope is moved, and therefore the angles between the stars, are measured with the highest precision.

The Clock.— The astronomical clock does not differ greatly in its construction from the ordinary clock. Its arrangement and the numbers on its face are, however, adapted to the measures of time used by astronomers. Mean solar time, which is the time we make use of in the affairs of daily life, is also used by the astronomer with a slightly different arrangement. Instead of the hours being designated as A.M. and P.M., the astronomer counts through the whole 24 hours. Moreover, the count does not begin at midnight, but at noon, which is therefore the commencement of the astronomical day. For purely scientific purposes this is the natural time to begin the day, because it is determined by the passage of the sun across the meridian. Therefore, any day of the month, as used by the astronomer, continues until noon of the following day, when a new day begins. For this reason the hour hand of his clock only makes one revolution in the 24 hours, the hours being numbered from 0 to 23. The astronomer makes use of a second system of time, entirely different from that used in daily life, being based on the apparent diurnal movement of the stars. We have explained, in the preceding article (ASTRONOMY) that the time between two passages of the same star over the meridian of a place is not quite 24 hours, but nearly four minutes less. This is the true time of rotation of the earth on its axis, because, in consequence of the advance of the earth in its orbit it must go through a little more than its true revolution in order that the meridian of any place on its surface — that of Washington for example — may again pass directly under the sun. The astronomer therefore uses a "sidereal day," which is shorter than the day determined by the sun in the proportion 365.24:366.24. This day is divided into 24 sidereal hours, and each hour into sidereal minutes and seconds, according to the usual system. A sidereal clock is regulated so as to gain about 3 m. 56 s. every day on our ordinary clocks and, in this way, keep time with the apparent diurnal movement of the fixed stars. It is so set that it shall read 0 h., 0 m., 0 s. at the moment when the vernal equinox crosses the meridian. As any of us, by looking at the clock, can tell, by the time of day, whether the sun is in the east, south, or west, so the astronomer, by his sidereal clock, can tell in what part of its apparent diurnal course any star may be situated. For examples, at 5 h. he knows that the constellation Auriga is on the meridian, and at 18 h. 30 m. that the beautiful Lyra is crossing the meridian.

The Chronograph.— There are two systems by which the astronomer notes the time of occurrence of an instantaneous phenomenon to a fraction of a second. On the older system, which is not without its advantages, the observer, looking at his clock, counts its beats until the occurrence of the phenomenon he is to observe. We may take, as an example, the occultation of a star by the moon. He sees the limb of the moon approaching the star until it is clear that, in a few seconds, it is going to pass over it and hide it from view. Then, looking at the clock, he listens to the seconds, mentally counting the number of each beat. At length, there is a certain beat of the clock when the star is not yet hidden, while before the next beat the star has disappeared from view. He estimates how many tenths of the interval between the beats of the clock had elapsed when the star disappeared, and records the hours, minutes, seconds, and tenths in his note-book. The skilled observer will seldom be more than a few tenths of a second in error in this estimate. It requires long practice, and much natural aptitude, to be able to make an accurate observation in this way. The method has also the inconvenience that there is no permanent record except that which is written down at the moment, so that, if the observer has made an error of any kind, he has no direct way of detecting it except by subsequently discovering that something must be wrong. This difficulty is avoided by means of a chronograph. In the form commonly used, the chronograph consists essentially of a cylinder, generally about eight inches in diameter and one or two feet in length, revolving on its axis by clock work at the rate of one turn a minute. Around the cylinder is stretched a sheet of paper, which is carried with it in its motion. The sheet is pressed by a pen, pencil, or other point, so as to leave a mark on the paper as the cylinder revolves. The pen is carried by a little carriage moving slowly forward from one end of the cylinder to the other at a rate of about one tenth of an inch, or a little more, in a minute. Consequently, the point describes a spiral line on the paper as the chronograph goes through its successive revolutions, until the pen arrives at the farther end of the cylinder. This may take a period of two, three, or four hours, according to the adjustments. The pen is connected with an electro-magnet, the current around which passes through the works of the clock. The arrangement is such that at every beat of the clock, or sometimes at every alternate beat, the electric current is either closed or broken. With each closing or breaking of the current a slight motion is given to the pen so that the seconds are marked on the paper on the revolving cylinder. The same or another current also passes through a key held in the hand of the observer. When the latter sees the moment of the phenomenon he is to note approaching, he holds the key in his hand, and presses it at the exact moment to be recorded. A motion is thus given to the pen, and the posi-



1. Six-inch steel Meridian Circle, U. S. Naval Observatory, Washington, D. C.
2. Steel Position Micrometer

tion of the signal on the paper among the signals given by the clock shows the moment to a fraction of a second at which the signal was given.

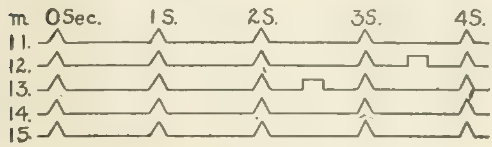


FIG. 6.

Different systems are used based on this general principle. There are various ways in which the pen marks the clock beats on the paper. In that mostly used in this country the pen is not raised from the paper, but is given a sudden lateral jerk, producing a notch in the line, as shown in Fig. 6, which is a copy of a small portion of a chronograph record. On another system the pen simply makes dots on the paper at each beat of the clock. Sometimes the current passes around the electric magnet all the time except at the instant a signal is made. Then one and the same electric circuit is used for both the clock and the observer. Sometimes the clock only makes the circuit at the moment of its beat; then the circuit at the command of the observer is a second one, which he makes by pressing the key. The main point in all systems is that the beginnings of the minutes all come under each other so that, by taking the sheet off of the cylinder, and spreading it out, writing in the minutes and the lines of seconds, the observer can determine the exact moments at which every one of any number of signals were made while the chronograph was running. For example, in Fig. 6 it will be seen that the observer pressed the key at 12 m. 3.5 s. and again at 13 m. 2.4 s.

The Spirit Level.— Another appliance much used in astronomy is the spirit level. It serves to set the axis of an instrument exactly horizontal. It consists of a glass tube, generally six or eight inches long, of which the rounded surface is not a perfect cylinder, but is formed by the revolution of the arc of a very large circle around its chord. The tube is therefore of the shape shown in Fig. 7, slightly larger in the middle part than at the two ends. The amount of bulging is, however, so slight that the eye cannot perceive it. In the most delicate levels, a section of the curved surface is an arc of a circle perhaps half a mile, more or less, in diameter. The tube is nearly filled with chloroform or ether. Water, or even alcohol,

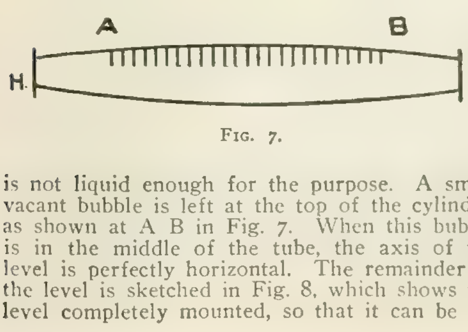


FIG. 7.

is not liquid enough for the purpose. A small vacant bubble is left at the top of the cylinder, as shown at A B in Fig. 7. When this bubble is in the middle of the tube, the axis of the level is perfectly horizontal. The remainder of the level is sketched in Fig. 8, which shows the level completely mounted, so that it can be set on the horizontal pivots of the instrument of observation. The true horizontality of the pivots is tested by reversing the level end for end, reading the position of the bubble at each

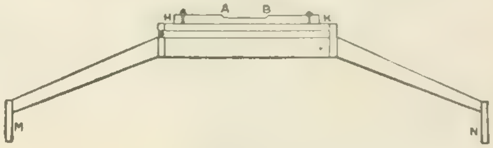


FIG. 8.

setting. Details need not be entered into at present, as we only wish to make the principle of the instrument clear. Nearly all instruments for astronomical measurement are made by putting together some combination of the devices we have described. The two combinations most used in astronomical observatories are the Meridian Circle or Transit Circle, which are the same in principle, and the Equatorial Telescope.

The Meridian Circle.— This instrument is used for two distinct purposes. One is the determination of the right ascensions of the heavenly bodies; the other the determination of their declinations. It will conduce to clearness to consider these two functions separately and begin with the instrument as adapted to the first purpose. In this form it is called the transit instrument and is shown in Fig. 9. It consists essentially of a telescope, mounted on a

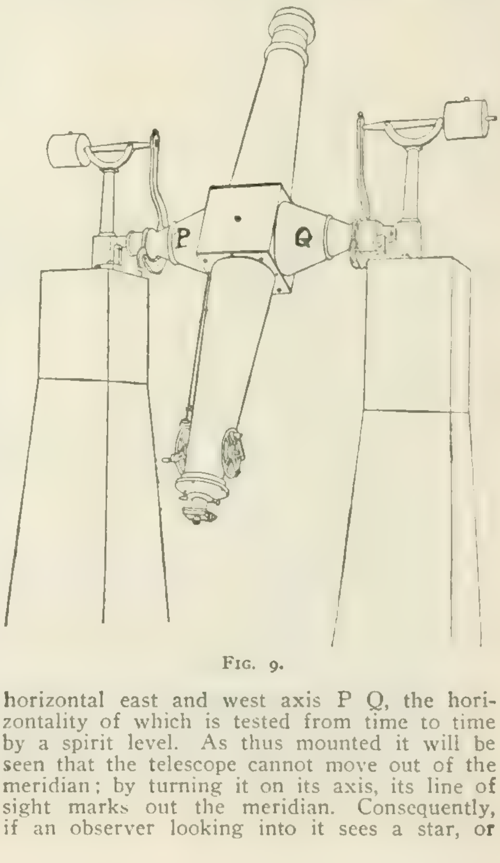


FIG. 9.

horizontal east and west axis P Q, the horizontality of which is tested from time to time by a spirit level. As thus mounted it will be seen that the telescope cannot move out of the meridian; by turning it on its axis, its line of sight marks out the meridian. Consequently, if an observer looking into it sees a star, or

other heavenly body, he knows that the star must be near the meridian. To make the observation more exact, a system of spider lines, shown in Fig. 10, is stretched across the focal

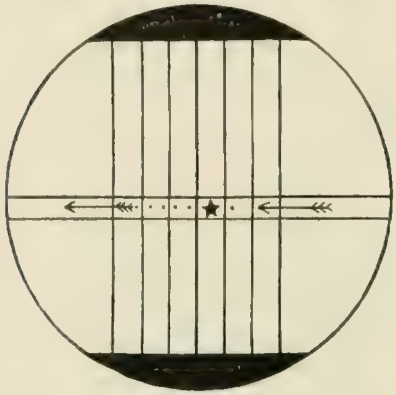


Fig. 10.

plane, as already described. The middle line is so adjusted as to mark the meridian with the greatest possible exactness. The result is that the observer, looking into the instrument, sees these spider lines, and he may also see a star moving toward the meridian by virtue of its apparent diurnal motion as shown in the figure, where it is about to cross the meridian line. Watching it with a key connected with the electric circuit of the chronograph in his hand, he taps the key at the moment the image of the star crosses each of the lines. The middle line marks the passage across the meridian. The other lines are used in order to secure greater exactness by taking the mean of all the transits across the separate lines. Thus, by pointing his instrument into any part of the meridian, the observer may determine the times by his sidereal clock at which any number of stars crossed the meridian of his place.

In order that the line of sight of the instrument may describe the true meridian, it is necessary that, when the instrument is turned in the proper direction, the line shall pass

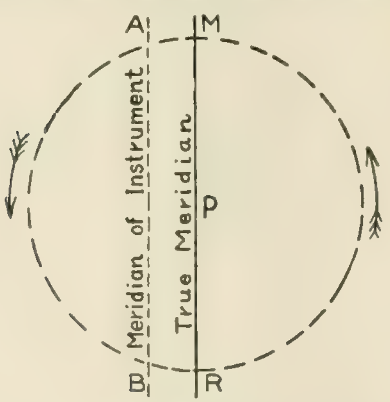
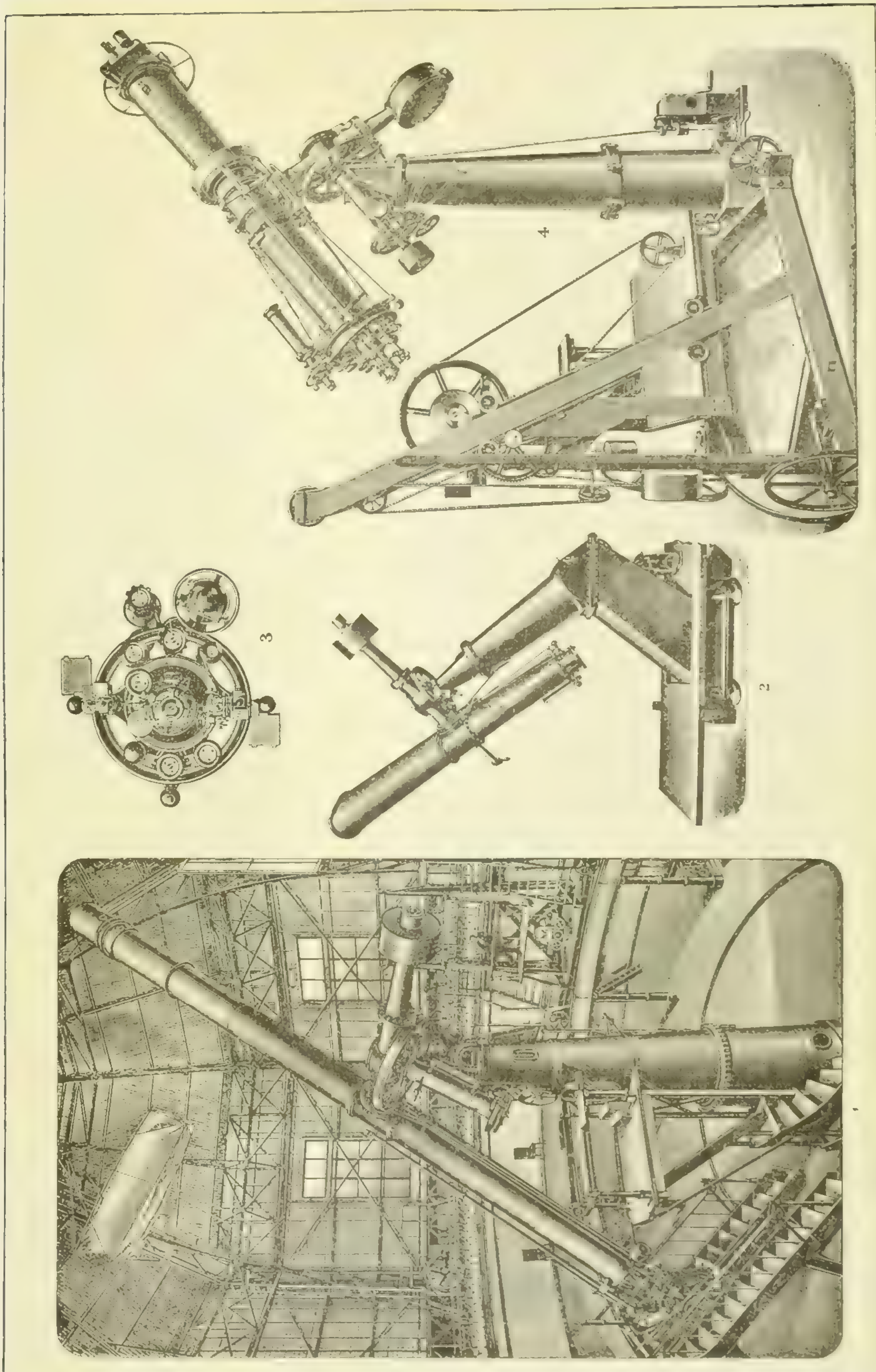


Fig. 11.

through the celestial pole. This is effected by the following arrangement: In the course of its apparent diurnal motion, a star near the pole will cross the meridian of any place twice in the course of a sidereal day, first above the pole and then below it. Let the dotted circle in Fig. 11 be its apparent diurnal circuit around the pole P. Let the vertical line M R be the true meridian passing through the pole, and the other line A B that marked out by the line of sight of the transit instrument, supposed not to be exactly in the meridian. Then the star will take a less time in passing around from A to B on the left than in the other part of its course from B to A. Therefore by observing the transit both above and below the pole, across the middle thread of the instrument, the observer determines whether the line of sight of the instrument passes east or west of the pole and may adjust it accordingly. It may be said that, in astronomical practice, no instrument is ever assumed to be perfectly adjusted. The clock of the astronomer is never assumed to be correct, nor his transit instrument to be in the true meridian. What he does is, assuming them wrong, to make his observations, determine the errors, and correct his observations accordingly. This is called "reducing" the observation. We have already explained that, when a star is exactly in the same hour circle with the vernal equinox, its right ascension is 0 h., 0 m., 0 s. Since the clock, assumed to be correct, then reads exactly 0 h., it follows that the star in question will cross the meridian at this time by the clock. Then, as the sphere revolves, the right ascensions of the stars are all equal to the sidereal time at which they cross the meridian. Thus the observer by noting these times, measures the right ascensions of the heavenly bodies. This system of using the clock instead of a divided circle for determining right ascensions constitutes one of the greatest advances ever made in astronomical measurement. It depends upon the perfect uniformity of the earth's rotation and the excellence with which a clock can be made.

The Meridian Circle is the transit instrument, just described, with one or two graduated circles on its axis of rotation. The method of using it, and determining the arc through which the circle has moved at any time has already been explained. The inquiring reader may wish to know how, by such readings, the astronomer can determine the declination of stars. If the celestial pole were a visible point in the heavens, this would be very simple; the observer would turn his instrument until it pointed exactly at the pole, and then read his microscopes. Then as one star after another crossed the meridian, he would make a similar pointing, reading his microscope for the transit of each star. The difference between the reading on the pole and that on the different stars, would show their distances from the pole. Subtracting each of these from 90° would give the declination of the stars as seen in the instrument.

But, unfortunately, the pole is not a visible point. The observer has therefore to refer his position to the direction of gravity, which is done by a very ingenious use of a basin of quicksilver. The basin is set on a firm support on the ground under the telescope, and the latter is pointed directly downward. The observer, by mounting up to the eye-piece and looking down, is looking perpendicularly into the basin of mercury. A combination of reflectors is then arranged in the eye-piece of the



1. Equatorial in the Observatory at Pulkova. 2. Photographic Refractor. 3. Eye-end of No. 4. 4. Heliometer.

telescope so that he can, at the same time, see the threads in his eye-piece and the images of these threads as reflected from the basin of mercury. When a telescope is so adjusted that the image and the thread coincide, he knows that the line of sight of his telescope is truly vertical. He then reads the microscope of his circle and so determines what the reading of his circle is for the vertical position. He knows that if the telescope is pointed at the zenith, the reading will be different by exactly 180°. He thus determines the exact distance at which the heavenly bodies crossed the meridian north or south of his zenith. From this, the determination of the declination is, in principle, a simple matter.

The Equatorial.— One of the most important arrangements of nature with which the astronomer has to deal is the diurnal motion. This takes place so slowly that, in looking at the stars, we do not notice it unless we watch for some time. But, if we point a telescope at a heavenly body, it magnifies the diurnal motion as much as it does the object. The result is that such a body, seen in a fixed telescope, is continually traveling across the field of view, and the instrument has to be continually moved to keep up with it.

In order to avoid this inconvenience, it is necessary that, if measures are to be made upon the body, or if it is to be continuously studied, the telescope must move to correspond. This is brought about by mounting it upon an axis parallel to that of the earth, and therefore oblique to the horizon, called the polar axis. The inclination to the horizon must be equal to the latitude of the place. All great telescopes are thus mounted. The way in which this is done will be seen by the accompanying picture of the great telescope mounted at Pulkova, Russia. In order to keep the telescope pointed at the object, it must be turned upon the polar axis by clock work, moving it steadily at a rate equal to the diurnal motion of the object observed. In reality, the telescope is then pointed in a fixed direction, the motion of the earth being simply neutralized by the clock work of the telescope carrying the latter in the opposite direction. The equatorial telescope must also have a second axis, called the declination axis, in order that it may be pointed at stars in different declinations. The direction is determined by circles attached to the telescope, which show, at any time, to what declination on the celestial sphere the instrument is pointed. By a combination of contrivances, the astronomer can point his telescope by day at any star bright enough to be visible in it; or, by night, at any object invisible to the naked eye, of which he knows the right ascension and declination. He first turns his telescope until one divided circle corresponds to the declination of the star, and then clamps it in that position. Then, looking at his sidereal clock, and taking the difference between the sidereal time and the right ascension of the star, he turns his telescope on the polar axis until the other circle shows the correct pointing. Then he starts the clock work which sets the telescope in motion, and looking into the eye-piece, sees the required object. Every large telescope is also supplied with a finder. This consists of a smaller telescope fastened to the larger one in such a way that the centre of the field of view is the same in both. But the finder has a lower magnifying power, and therefore a much larger field. Looking into it, and recognizing the object he wishes to observe, the observer moves the telescope until the object is seen on the cross threads of the finder. Then he knows that it is in the field of view of the large telescope.

Application of Photography to Astronomy.— From the time that photographic methods were introduced, the idea of taking pictures of the heavenly bodies by such methods must have occurred to astronomers. About the year 1840, Prof. J. W. Draper of New York put this method into practice by taking a daguerreotype of the moon. Shortly after our present system of photography was devised, several American astronomers carried the experiment yet farther. Notable among these were G. P. Bond, first assistant and afterward director of the Harvard Observatory; and L. M. Rutherfurd of New York, who was the possessor of an excellent telescope, and brought the method to a high state of perfection.

The principle on which a photograph of a heavenly body is taken is extremely simple. A telescope is pointed at the body so that the image of the latter is formed in its focus. A sensitized plate is placed in the focus and exposed for the necessary time. This may be only a fraction of a second, or it may be several hours. Unless the exposure is very brief, it is necessary that the telescope shall be kept in motion, so as to follow the object in its apparent diurnal course. When the exposure is completed, the image is developed in the usual way. In photographing, the ordinary telescope, as used for eye observations, is not well suited to the purpose, for the reason that the chromatic aberration is not the same for the visual and for the photographic rays. It is necessary to have a somewhat stronger crown lens, or a weaker flint lens, if a telescope is to be used in photographing, than if it is to be used by the eye. But the necessity of having telescopes of the two kinds is now, to a certain extent, done away with by the use of sensitized plates which are especially sensitive to the visual rays. By putting in an absorbing screen, through which the rays must pass before they reach the focus, and which allows only the visual rays to pass, very accurate photographs can be taken by the plates. This defect is felt only in the refracting telescope. A reflecting telescope brings all the rays, of whatever color, to one and the same focus, and therefore may be used either for photographing or for seeing. Improvements made in recent times in the sensitiveness of photographic plates have given an enormous extension to this method in astronomy. It is now found that celestial objects completely invisible to ordinary vision can be photographed. While only a few thousand nebulæ have been catalogued as visible to the naked eye, it is found that there are hundreds of thousands which admit of being determined by photography.

The latter is now employed for two distinct purposes. The first is simply that of forming a picture of the sky, or rather of the stars in the sky. For this purpose the best telescope is one as large as can conveniently be obtained, but of short focal length. A great enterprise in this direction was started in 1887 by an association of astronomers who met at the Paris Observatory, and put into operation a plan of photographing the entire heavens on from 10,000

to 20,000 plates, each two degrees square. This work is now approaching completion, and is intended to form a permanent record of the starry heavens, as they are seen in our times. A similar object is reached on a different system at the Harvard Observatory. There photographs are being constantly taken with telescopes much shorter than those used for the international chart. In this way new stars are from time to time discovered, and variations in the light of different stars are brought out. The other purpose is that of exact measurement. When the astronomer had to determine the respective distances of stars in the same field of view, he has hitherto generally depended on the filar or other micrometer. The use of this instrument is laborious. When the photographic method is used, he simply takes a picture of the stars he wishes to measure, and, at any convenient time, places it under a measuring engine supplied with sliding microscopes, and measures off the distance on his negative. The result of these two applications is that photography is now slowly supplanting eye observations in an important fraction of the astronomical work of the world.

SIMON NEWCOMB, LL.D.,
Washington, D. C.

Astronomy, Theoretical. This branch of the science grows out of the great discovery of Newton, that the motions of the heavenly bodies, especially those of the solar system, are determined by their mutual gravitation. The results of this theory are now worked out by purely mathematical methods with a degree of precision scarcely attainable in any other branch of science. The adopted method consists first in expressing the attraction or pull experienced by each body from all the others in the form of differential equations. These equations express, in the most general way, the acceleration which the planets experience at every moment from the attraction of the other bodies. We do not write them because they would be understood only by a reader expert in the calculus, who, if he desires to be acquainted with them, will consult special treatises. It will suffice to say that there are three differential equations for each planet, which express the attraction, and its effect on the motion of the planet at any instant, in the direction of three co-ordinates. The problem then becomes the purely algebraic one of integrating these equations. The result of this process is that the effect of the attraction or pull upon the body, through a period of days, years, or even centuries, is summed up with great exactness, so that the motion of the body through the whole period can be expressed by algebraic equations. The simplest case occurs when there are only two bodies. The integration shows that, in this case, the bodies revolve round their common centre of gravity in orbits each of which is an ellipse. Commonly it is necessary to consider only the motion of the smaller of the two bodies, the motion being defined as if the larger were at rest. This is the case of a planet revolving round the sun, or of a satellite round its primary. It is then found that the orbit described by the revolving body round the great central body is an ellipse having the latter in one of its foci. The motion is also found to be subject to two other laws which bear the name of Kepler, their first discoverer. One of these is that the radius vector, that is to say, the line drawn from the central body to the other sweeps over equal areas in equal times. The result of this is that if A B be the orbit having the sun, S, in the

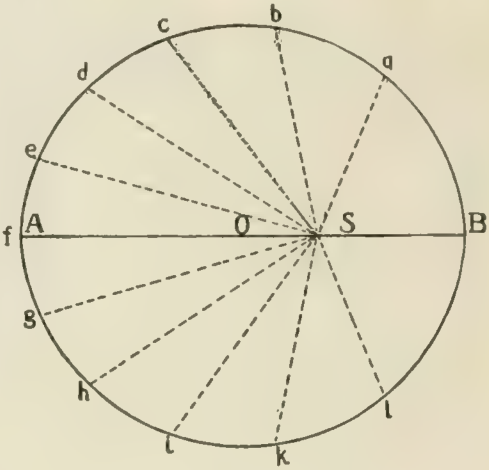


FIG. 12.

focus; and if we mark on the orbit the points *a*, *b*, *c*, etc., which the planet passes through at any equal intervals of time, and then draw lines from each of these points to the sun, the areas included between these lines will all be equal to each other. A glance is sufficient to show that the nearer the body is to the sun the more rapidly it must move.

The position of the orbit and the place of the body in it are determined by six quantities called *elements*. Two of these elements express the position of the plane in which the ellipse lies, and therefore in which the planet moves. These are the inclination of the plane of the orbit to some other plane taken as that of reference. For the latter is commonly adopted the plane of the ecliptic, in which the earth revolves round the sun. When the inclination of the orbit of any other planet is spoken of, the astronomer means the angle which the plane of its orbit makes with the plane of the ecliptic. The other of the two elements expresses the line passing through the sun along which the two planes intersect. This is called the Line of Nodes. The position of the node is defined by the angle, as seen from the sun, between the vernal equinox and that node where the planet crosses from the south to the north side of the ecliptic. Three other elements determine the size and form of the elliptic orbit, and its position in its plane. The semi-major axis, A B, of the ellipse is called the mean distance of the planet from the sun, it being half the sum of the greatest and least distances. The other of these elements is the eccentricity of the orbit, which is equal to the quotient obtained by dividing the distance of the sun, O S, from the centre of the orbit by O A, the semi-major axis. These two elements completely determine the ellipse. The exact position of the ellipse in the plane may then be defined by the angle which the semi-major axis, O B, makes with the line of the nodes. It will be seen that the point B is that at which the planet is

nearest to the sun. This is called the perihelion of the orbit if the central body is the sun; if the earth is the centre, the perigee. The opposite point, A, where the planet is most distant, is called the aphelion, or apogee. Finally, the sixth element defines the position of the planet at some given moment of time.

The time of revolution of the planet is given by Kepler's third law, which is that the squares of these times are proportional to the cubes of of the major axes of their orbits. For example, let one planet be four times as far as another from the sun. The cube of 4 is 64. The square root of this is 8. It follows that the planet which is four times as far will be eight times as long in completing its circuit. If the outer planet went as rapidly as the other, it would be only four times as long. Its orbital motion is therefore, on the average, only about half as rapid.

In theoretical astronomy a unit of distance is necessary. Our ordinary units do not well serve the purpose of the astronomer for two reasons. They are too short for the great distances he has to measure, and the magnitude of the heavens in terms of miles is not known with sufficient exactness to make that measure convenient. What the astronomer does therefore is to take the mean distance of the earth from the sun as his yardstick, and to express the distance of all the bodies of the solar system, both from the earth and from each other, the moon sometimes excepted, in terms of this unit.

From the laws of motion based on gravitation may be derived several interesting theorems. Finally, suppose, that at some point in the solar system,— we may take, to fix the ideas, a point at the mean distance of the earth from the sun,— a number of bodies are projected in different directions, but all with the same velocity. Then, the equations of motion show that the major axes of the orbits which these bodies describe will all be equal. Then, from Kepler's third law it follows that the times of revolution will also be equal. Consequently, at the end of a certain period the bodies will all return at the same moment to the point from which they started. This period will depend only on the velocity with which the body is projected. There is a certain velocity, called the circular velocity, which is such that if the bodies are projected in a direction at right angles to that of the sun, they will describe circular orbits. If all the bodies are projected in different directions with this same velocity, they will all be exactly one year in getting around and returning to the starting point. Now suppose that, instead of the bodies being projected with this circular velocity, which is very nearly that of the earth in its orbit, they are projected with a somewhat smaller velocity. Then, the less the velocity the less the major axis of the orbit, and the greater the velocity the greater the major axis. A body projected with a speed one-third greater than that of the earth would fly out beyond the orbit of Jupiter. A slightly greater speed would carry it beyond the orbit of Neptune, the reason being that, as the body recedes, the attraction of the sun diminishes at so rapid a rate that the weak attraction left is not sufficient to overcome the slight surplus velocity. Finally, if the speed is equal to that of the earth multiplied by the square root of 2, that is to say, about 26 miles per second, the body will never return. The ellipse in which it should move is stretched out into a parabola, still having the sun in its focus. If the velocity is greater than this, the parabola will be still farther changed into a hyperbola. Then the body would fly out into the stellar spaces, perhaps in the course of millions of years reaching some other sun, but would certainly never return to our system. Another theorem is that the velocity, no matter what the form of the orbit, diminishes as we go out from the sun in proportion to the square root of the distance. This we have already seen by Kepler's third law, when we found from that law that a planet four times as far from the sun would move only half as fast. Thus the parabolic velocity is less the farther a body is from the sun. At the planet Uranus it is less than six miles per second; at that of Neptune, about five miles per second. Still another theorem is that if a planet moving in a circular orbit were stopped at any point of its motion, and then were allowed to drop toward the sun, the time of reaching the sun would be equal to that of revolution divided by the square root of 32. It follows that if the earth should be stopped in its motion, it would drop to the sun in a number of days found by dividing 362.24 by the square root of 32. This would be nearly 64 days.

The orbits of most of the large planets are nearly circular. For particulars relating to them see SOLAR SYSTEM. The orbits of comets are, however, mostly parabolas, or ellipses which cannot be distinguished from parabolas when the comet is near enough to the sun to be visible. It is probable that many of those orbits which are ellipses have become so through the comet at some time in its history passing very near a planet. (See COMET.) One of the problems of theoretical astronomy which the astronomer often meets with is that of determining the orbit of a newly discovered body of the solar system. Three complete observations of such a body, that is to say, three observations each of which determines exactly the apparent position of the body on the celestial sphere, enable the astronomer to determine the orbit in which it is moving round the sun. The calculation requires from five to ten hours' work by an expert calculator having at his command the necessary tables. The first orbit thus computed may be considerably in error, because the effect of errors of observation is multiplied many fold, unless the planet has moved through a considerable arc of its orbit between the times of observation. But the longer the planet is observed, the more exactly the elements of its orbit can be determined. It is found that when two stars are so near each other as to be kept together by their mutual attraction, they revolve around each other in an elliptic orbit. It follows that the law of gravitation extends to these systems. Thus the calculations of the theoretical astronomer are not confined to the solar system, but may be extended to the fixed stars.

In all that precedes we have considered only the motion of two bodies, the smaller of which moves around the larger in an elliptic orbit. But, as a matter of fact, every planet of the solar system is acted upon not only by the great central body, but by every one of the other

planets. The result is that the actual orbit, although very nearly an ellipse, deviates slightly from it, and the motion is not exactly in accordance with Kepler's laws. The problem of taking account of these additional forces is an extremely complicated one, in which success has been reached only by successive generations of the ablest mathematicians devoting long years of study and calculation to the subject. While the solution, even to-day, is far from complete, it has been so far advanced that it is possible to prepare tables of the motions of the planets which shall hold good for generations, and even for centuries. The method in which the problem can best be solved was devised by Lagrange, who flourished in France toward the latter part of the 18th century. The fundamental idea of his method was that the motion of the planet at every instant should be represented by an ellipse, but this ellipse continually changes its form and dimensions so as to fit in with the actual motion of the planet under the influence of the attraction of all the other planets. Some idea of the case may be imagined by supposing a cord of some light material made into an ellipse very nearly a circle, and left to float on the waves of the ocean. Then we should see the cord, while still remaining almost in its original shape, continually bending and twisting as it was moved by the waves. So does the variable ellipse in which the planet moves. It is exactly defined by supposing that, at any one instant, the attraction of all the other bodies, the sun excepted, ceases. Then the planet would move in a fixed and unchangeable ellipse. This ellipse is taken as that which corresponds with the motion of the planet at the instant. At a second instant the planet would actually have deviated slightly in consequence of the attraction of the other planets, but there would still be a corresponding ellipse, but somewhat different. So the ellipse goes on changing continually.

When these changes are subjected to the rigor of mathematical formula, it is found that they nearly, but not quite, compensate each other in the long run. Let us take, for example, the eccentricity of any one orbit. This will vary in the course of every revolution of the planet, and may come back to its original amount any number of times. But, if we watch it revolution after revolution, we shall find that, in the long run, it continually increases or diminishes. It is thus found that the eccentricity of the earth's orbit has been diminishing through all historic times, and this diminution will go on for 43,000 years to come. Moreover, the general rule is that the perihelion of the planet is gradually moving forward. In the case of the earth's orbit the motion is such as would carry it all the way round the circle in 200,000 years. The inclinations and longitudes of the nodes are also varying in the same way. These variations, which go on century after century, are called secular variations, while those which are compensated from time to time are called periodic. Now, the most interesting and important question of celestial mechanics is whether the secular variations will continue forever in the same direction. The profound analysis of Laplace and Lagrange shows that such will not be the case so far as the eccentricities are concerned. At the end of immense periods the direction will be reversed. It is now known that the diminution of the eccentricity of the earth's orbit after continuing for about 43,000 years will change to an increase for a certain period. It is thus with all the orbits; the motions go through a series of oscillations having periods of hundreds of thousands of years — like "great clocks of eternity which beat ages as ours beat seconds." The precision with which the astronomer is now able to predict the motions of the heavenly bodies is reached by a combination of mathematical computations of the most difficult and complicated character, with the most refined observations upon the positions of the moon and planets, year after year.

The most complex of all the problems is that of the moon's motion around the earth, of which we shall mention some features. In this case the central body, the earth, is vastly smaller than the sun. But, owing to the great distance from the sun and the consequent small difference in the force of its attraction upon the earth and moon, it happens that the moon revolves around the earth in an orbit which approximates to an ellipse. But the changes and motions in this ellipse are much larger and more rapid than in the case of the planets. For example, the perigee of the moon's orbit makes a revolution round the earth in eight years, while the node on the ecliptic makes a revolution in 18.6 years. The moon also makes two swings back and forth during the space between two full moons, and the eccentricity and perigee both make an annual swing, all owing to the action of the sun. See Moon.

The principles of theoretical astronomy, and the operations of practical astronomy are combined in one of the greatest achievements of the human intellect — that of measuring the heavens and weighing the planets, and, in a few cases, even the fixed stars.

The distance of the moon is determined in two ways, the results of which agree within the necessary range of uncertainty of the methods. One is by the measurement of the moon's parallax, taking as the base line two distant observatories, Greenwich and the Cape of Good Hope. (See Parallax.) The other method consists in determining exactly what ought to be the size of the moon's orbit in order that she may make her revolution around the earth in the time that she actually does. The probable error of the distance of the moon at any time, as determined in this way, is not more than 40 or 50 miles.

The proportions between the orbits of the several planets are known with the greatest exactness from their observed times of revolution, and from Kepler's third law. It follows that if we can get the exact distance of any one planet at any one time, all the other distances in the solar system may be derived by the known proportion. The fundamental quantity which is used as a unit of measure is the distance of the sun. This distance has been determined by four completely separate and independent methods, the agreement between which illustrates the great exactness of astronomical theory.

The first method is by measures of parallax. The application of this method is fully described in the article Parallax. It requires that the apparent direction of a planet among the stars

be observed with great exactness from two far distant points of the earth's surface, or at two times of day during the interval between which the observer is carried around by the rotation of the earth. These observations have to be on a planet and not on the sun, because the latter, owing to the brilliancy of its light, cannot be measured with the necessary precision. The most celebrated way of determining parallax has been by observing transits of Venus (q.v.). But these occur at such rare intervals, the last having been in 1882, and there being no other to occur during the 20th century, that the measures have to be made on other planets which approach nearest to the earth. For this purpose Mars has sometimes been used, because it occasionally approaches us within less than half the distance of the sun. But the most exact observations can be made on some of the minor planets at the time of their nearest approach.

The second method is by the velocity of light. This method is, in principle, the most simple and elegant of all. It rests on the fact that it is possible, by two kinds of observation, to determine how long it takes light to pass from the sun to the earth, or to cross the earth's orbit. If then we can determine by measures on the earth's surface how fast light travels, it follows that by multiplying this velocity by the time it takes to travel from the earth to the sun, we shall have the distance of the sun. The velocity of light has actually been determined with great precision by means of the revolving mirror. (See LIGHT, VELOCITY OF.) The result is a speed of 186,300 miles per second. The time required for light to cross the earth's orbit is much more difficult to determine. The only way in which a direct determination can be made is through observations of the eclipses of Jupiter's first satellite. By comparing the times of these eclipses through a long series of years when Jupiter is at various distances from the earth, it is found that the eclipses are seen later, the farther Jupiter is from the earth at the time. This is because light requires time to travel over the different distances. But the determinations made in this way are not very exact, because such eclipses take place so gradually that it is impossible to fix upon a precise phase without a possible error of several seconds. All we can say as a result of this method is that it takes about 4 m. 20 s. for light to pass from the sun to the earth.

A more exact result is reached by measuring the displacement of the fixed stars produced by aberration. As the earth makes its annual course around the sun, the position of every star in the heavens is, at every moment, slightly displaced toward the direction in which the earth is, at the moment, moving. This is due to the proportion between the velocity of light and the speed of the earth in its orbit. Unfortunately, the speed is so great that the displacement in question is only about 20.5″; an arc too small to be determined with the precision that is desirable. Still, the observations available are so numerous that the result, 20.525″, found by Chandler, is probably within one, or, at most, two hundredths of a second of the truth. Accepting Chandler's number, light requires 500 seconds to pass over the distance which separates the sun from the earth. Multiplying this by the speed of light, we have, for the distance of the sun $186,300 \times 500 = 93,150,000$ miles as the distance of the sun.

The third method is a very recondite one, because it rests on the mathematical principles of celestial mechanics, applied to the case of the earth's motion around the sun. It requires, in advance, an exact determination of the ratio of the mass of the sun to that of the earth. This is best found by observations of Venus, which now extend through more than a century and a half, by which the motion of the node of Venus on the ecliptic is determined. This motion is due principally to the attraction of the earth; and from it the proportion between the mass of the earth, and that of the sun is determined. The next step requires a comparison between the distance which a body falls at the surface of the earth from its own gravitation, and the fall of the earth toward the sun as shown by the curvature of its orbit. By combining these various ratios, the distance of the sun is calculated. The fourth method also rests the theory of gravitation. One consequence of the sun's action on the moon is that the latter falls behind about two minutes in its monthly course near the time of the first quarter, and is ahead by the same amount near the last quarter. Knowing the exact amount of this swing, the distance at which the sun must be placed in order to produce it is determined. Each of these four methods has its strong and its weak points; and there is no one of them so much better than all the others that we can rely upon it exclusively. Still, their agreement affords a remarkable proof of the accuracy of astronomical theory, and of the precision with which astronomical measures are made under such difficulties as the observer and computer have to encounter. The astronomer does not use the distance of the sun in his computations, because, as already remarked, this is simply his unit of length. What he actually uses is the sun's parallax; this is equal to the angle which the equatorial radius of the earth subtends when seen at a distance equal to that of the sun. The latest results for this parallax from the four methods are the following.

First method, parallax, 8.802″.
Second method, light, 8.779″.
Third method, mass earth, 8.762″.
Fourth method, moon, 8.773″.

The general conclusion which we reach is that the distance of the sun is very nearly 93,000,000 miles, probably a little more, rather than a little less.

What may seem a yet more wonderful result of celestial measurement is the weighing of the planets and other heavenly bodies. This requires very complex mathematics. But, after all, the principles on which the method rests can readily be made clear. In the case of the planets, there are two methods, one of which can be applied only when a planet has a satellite moving around it. We have already seen that the motion of every planet which, were there no other planet, would take place in an ellipse having the sun in a focus, is changed by the attraction of the other planets. The observation of the deviations, when carefully measured through many revolutions of a planet, enable the mathematical astronomer to compute the ratio of the mass of each attracting planet to that of the sun. This ratio is all that the astronomer requires for his ordinary work.

When the planet has a satellite, its mass can be determined with much more ease and simplicity. The measurement of the distance of the satellite from the planet, carried through a great number of revolutions of the former, enable the astronomer to determine the ratio between the distance of the satellite from the planet, and that of the earth from the sun. Combining this with the time of revolution of the planet, a proportion is shown between the mass of the planet and that of the sun by a law of the same form as the third law of Kepler. The masses determined by astronomical methods are all expressed by taking the mass of the sun as the unit. To translate the result into our ordinary measures of weight, we must know the mass of some one body, say the earth, in pounds or kilograms. How this is done is set forth in the article GRAVITATION.

SIMON NEWCOMB, LL.D.

Astrophysics, or the new astronomy, has revealed in a remarkable manner, through its discoveries during the past quarter of a century, the wonderful ability and resourcefulness of the human mind, making evident that man is almost an infinite being. From this earth of ours, which astronomy teaches is such an insignificant speck among the countless orbs of the universe, we have been able by means of the spectroscope to investigate the physical constitution of the sun, planets, comets and far-off stars; it has become possible to measure motions, not athwart the sky as the older astronomy was able to do, but in the line of sight; and it has been possible to arrange the stars in orderly series, tracing their evolution from the primeval nebula, till now we are well on our way toward the solution of the grandest problem of human investigation, whence came we and whither are we going. Since its birth in 1859, when Kirchhoff discovered the principles of spectrum analysis, astrophysics has advanced by leaps and bounds. This rapid progress was due in a large measure to the improvement of instruments and to the photographic plate. This important acquisition has a two-fold advantage over the human eye: the eye can receive and retain an impression for a small fraction of a second, the photographic plate accumulates impressions, no matter how faint, with the result that by long exposures there is brought to view objects the eye could never hope to see, and secondly, the photograph gives a permanent record that can be examined and studied at leisure. These improved methods of research have made possible a great increase in precision till at the present time, astrophysics is no whit less precise than its older sister, astronomy, the "most exact of all the sciences." A great change has come over our ideas of wave-length. Formerly, the wave-length was looked upon as an invariable property of a line in the spectrum, unalterably fixed by nature, and consequently it was thought that a wave-length determination would give a standard measure of distance more reliable even than that obtained by the use of the International Meter (Michelson, 'Astronomy and Astrophysics,' XIII., 92, 1894). But we now know that the position of the lines in the spectrum may vary with the pressure of the gas in which they are produced, and, moreover, single lines, by the action of a magnetic field, have been separated into as many as nine different components. There seems to be some law regulating the orderly arrangement of the lines in the spectrum in series, and the complete understanding of this law will be one of the important discoveries of the future. The shift of the lines of the spectrum due to motion in the line of sight, which has been shown experimentally in the laboratory, has given rise to many interesting developments in astrophysics, the discovery of an entirely new class of bodies called spectroscopic binaries, the measurement of the axial rotation of the sun and Jupiter, and has confirmed in a magnificent manner the meteoric constitution of Saturn's rings.

Instruments.— The vast increase in accuracy of spectroscopic work was rendered possible by the manufacture of Rowland gratings. Gratings were used as early as 1815 by Fraunhofer and were made by winding fine wire over two exactly similar screws. Rutherfurd of New York ruled some very satisfactory gratings on speculum metal, but these were surpassed in perfection by Rowland's. The invention of the concave grating gave a spectroscope without collimator or objective, thereby eliminating the aberrations brought in by these two lenses. The formula for resolving power which is defined as $r = \frac{\lambda}{d\lambda}$, where $d\lambda$ is the difference of wave-length of two lines of mean wave-length λ which can just be divided, can be easily expressed for gratings, and is the product of the total number of lines of the grating and the order of the spectrum. Ordinary six-inch Rowland gratings have a resolving power of about 400,000. This vast increase in accuracy, coupled with other properties of the grating, namely, normal spectrum, overlapping spectra and astigmatism, whereby comparisons are rendered easy by coincidences, have wonderfully augmented the power of the astrophysicist to determine accurate wave-lengths. The precision of wave-lengths has been still further increased by the use of interferometers. Four different kinds have been invented by Michelson, Perot and Fabry, Hamy, and Lummer. Michelson has been able with his interferometer to compare directly the wave-lengths of the prominent cadmium lines with the International Meter, and has separated lines less than 0.1 tenth-meter apart which appear single with the most powerful gratings, while Perot and Fabry have observed interference with the green mercury line at a difference of path of 790,000 wave-lengths.

Spectra of the Elements.— The invention of the concave grating and the manufacture of nearly perfect gratings, plane and concave, by Rowland enormously increased the accuracy of the wave-lengths in the spectra of the elements. The chief investigations in this field have been carried on by Rowland and his assistants, by Kayser, Runge, Paschen, Hasselberg, Liveing and Dewar, Eder and Valenta, Exner and Haschek, Hartley and Adeney, Trowbridge, Ames, Lockyer, Deslandres, Lohse and others, most of the wave-lengths for which may be found in Watt's 'Index of Spectra.' Accurate measures were made possible by the use of concave gratings and photographic plates. Rowland's 'Table of Solar Spectrum Wave-Lengths' is based on Bell's determination of absolute wave-length ('American Jour. Sci.,' XXXIII., March 1887).

For a discussion of methods of determining wave-lengths, see Perot and Fabry, 'Ann. Chim. et Phys.,' ser. 7, XV., 1899, also XXV., 1902 and Bell, 'Astroph. Jour.,' XV., 157, 1902. The infra-red spectrum of the elements has been investigated by prism and concave grating with the help of bolometer and radiomicrometer by Snow, Lewis, Rubens, Paschen, Julius, Nichols, and others. Short wave-lengths are absorbed by even a few centimeters of air, but Schumann ('Sitz. Akad. d. Wissens. in Wien,' CII., Abth. 2a, 1893), has greatly increased our information of this region of the spectrum. By means of a spectroscopic apparatus in a vacuum with lenses and prisms of fluorite, and photographic plates prepared by himself, a wave-length of λ1.000 was supposed to be reached. More accurate wave-lengths have been determined by Lyman using a concave grating ('Astroph. Jour.,' XIX., 263, 1904), who measured lines in the ultra-violet as far as λ1,033.

Line Series.— That there is some orderly arrangement in the lines of a spectrum was shown by Balmer's law for the hydrogen lines in 1885, and by the presence of numerous triplets in the spectra of magnesium, calcium, and zinc. Further researches by Kayser and Runge, Rydberg, and Schuster with the development by them of empirical mathematical formulæ, have led to a great deal of interesting information regarding these series of lines. The interdependence of astronomy and physics was clearly demonstrated, when Pickering in 1897 discovered a new series of lines in the spectrum of the star ζ Puppis. This was found to be one of the series due to hydrogen produced under conditions not realized in the physical laboratory. However, in a great majority of the elements, the series already discovered comprise only a small percentage of the total number of lines. The exact meaning of these series is as yet unknown, although several very promising attempts have been made to explain them from theoretical considerations. The chief among them may be mentioned those of Julius, Ames, Kövesligethy, and Stoney. Stoney ('Trans. Roy. Soc.' Dublin, 1891) has sought to explain multiple lines from dynamical considerations, comparing the motions of the molecule with those of the bodies of the solar system whose motions in ellipses are perturbed by the presence of other bodies. Stoney, moreover, shows that the conclusions drawn by these dynamical methods may also be considered valid under the electromagnetic theory of light, a statement which receives support from Preston's observations of the Zeeman effect ('Phil. Mag.,' XLVII., 176, 1899). For detailed information on spectral series, see Kayser's 'Handbuch der Spectroscopie,' Vol. II.

Change in Physical Conditions.— The early idea that the position of a line of a spectrum was the result of chance is still further modified by the change of the wave-length of a line resulting from a change in the physical conditions. Jewell noticed while measuring solar spectrum photographs that the arc lines of the comparison spectrum did not in many cases exactly correspond with the lines in the sun. This led to the investigations of Jewell, Humphreys, and Mohler ('Astroph. Jour.,' VI., 169, 1897), on the spectra of an arc under pressure of from one to 15 atmospheres. From measurements of the spectra of 53 elements, it was shown that the lines are shifted by pressure toward the red end of the spectrum, the amount of the shift being directly proportional to the increase of pressure, but being independent of the temperature. For a given element, the shifts of similar lines are proportional to their wave-length, but lines of different series, principal, first and second subordinate, are shifted in the ratios of 1:2:4.

The appearances of lines in a spectrum are greatly altered by other physical conditions. Eder and Valenta have found that argon gives three distinct spectra under different electrical conditions, Schenck that the spark line of Mg at λ4481, which has so often been considered as a sure sign of a high temperature, vanishes if the electrodes become so hot that they glow and begin to melt. Locker has made a great number of investigations on "enhanced" lines, or those which are brighter in the spark than in the arc. He explains their meaning on the assumption that the spark is hotter than the arc, an assumption which is hard to reconcile with other observed phenomena. In this connection, Kayser, in his excellent 'Handbuch der Spectroscopie,' Vol. II., p. 181, says: "We cannot assume any connection between the spectrum and the temperature of the body producing it, and all conclusions which are based on the temperature at which a line or band will appear are quite unsound." Enhanced lines are found in the spectrum of certain stars like α Cygni, and also in the flash spectrum taken at the time of a total solar eclipse of the sun. The presence of these lines is important, but it is difficult at the present time to tell their exact meaning

Solar Spectrum.— The infra-red solar spectrum has been investigated by Becquerel and Lommel to λ9500 by using phosphorescent screens, by Abney to λ27,000, who photographed with a special emulsion of silver bromide and collodion, and by Langley by the use of the bolometer to λ53,386. Rowland's 'Photographic Map of the Normal Solar Spectrum' (Baltimore, 1888), made with a powerful concave grating extending from λ3,000 to λ6,950, and his 'Table of Solar Spectrum Wave-Lengths' (Chicago, 1898), which contain accurate measures of some twenty thousand lines, give the most accurate information we possess of the solar spectrum, and have been accepted by all astrophysicists as the common standard of reference. Rowland's determination of relative wave-lengths leave little to be desired in accuracy. Measures were made by the method of coincidences which is rendered possible by the use of concave grating which permit two overlapping spectra to be photographed on the same plate without change of focus. However, the standard lines of the spectrum have not had their wave-lengths determined with equal accuracy, and they have not been quite properly spaced throughout the spectrum, with the result that at the Saint Louis Conference, 1905, a redetermination of Rowland's standards was regarded as one of the present greatest needs in astrophysics.

Eclipses have furnished interesting developments in the history of spectrum analysis. The spectroscope was first used at the eclipse of 1868 by Janssen in India, when it was shown that the prominences give bright line spectra,

thus showing they are masses of hydrogen gas. The lines were so bright that Janssen looked for them the next day without an eclipse, and found them readily enough. In 1869, the green "coronium" line was discovered; in 1870, Young discovered the "flash spectrum," which was photographed for the first time by Shackleton in 1896. At the eclipses of 1898, 1900, and 1901, Evershed, Lockyer, and Mitchell gave accurate determinations of wave-lengths from these reversed spectra, those of Mitchell being obtained by the use of a grating.

Stellar Spectra.— Modern stellar spectroscopes are best represented by the Mills spectrograph of the Lick Observatory (Campbell, 'Astroph, Jour.,' VIII., 123, 1898), by the Bruce spectrograph of the Yerkes observatory (Frost, 'Astroph. Jour.,' XV., 1, 1902), and that of the Astrophysical Observatory of Potsdam (Hartmann, 'Zeitsch. für Instrum.,' December 1901). The spectrographs are similar in having the slit placed at the focus of the great telescope, and a dispersion of three prisms giving a total deviation of 180°. By means of a guiding eye-piece, it is possible to keep the star's light centrally on the slit during the exposure. Since this exposure may last for four or five hours, it is necessary, in order to have perfect definition, to keep the temperature constant. This is accomplished by means of an automatic temperature control which will keep the prisms of the spectrograph within 0.1° C. during an exposure, when outside in the dome the temperature may change by several degrees. A stellar spectrum is photographed alongside a comparison spectrum in order to determine wave-lengths more accurately, and to give measures of the motion in the line of sight, the most important work of stellar spectroscopy. The spectrograms are most readily reduced by the Hartmann-Cornu formula:

$$\lambda = \lambda_0 + \frac{c}{s - s_0},$$

where λ_0, c, and s_0 are constants and s is the scale reading of the line whose wave-length is desired. The motion in the line of sight in kilometers per second corresponding to the displacement $\Delta\lambda$ is given by

$$V_s = \frac{V_L\,\Delta\lambda}{\lambda}$$

where V_s is the desired velocity of the star, and V_L the velocity of light in kilometers. The most prominent workers in radial velocity have been Campbell, Vogel, Dunér, Frost, Keeler, Hartmann, and Bélopolsky, who have pretty thoroughly surveyed the northern hemisphere. Wright of the Lick Observatory has gone to Santiago, Chile, for similar work in the southern heavens. The observers in this field have entered into co-operation in order to observe the same stars at certain times for the purpose of determining thoroughly the constants of the spectrographs used. Campbell has discovered many stars with variable radial velocities, thus showing they are accompanied by one or more companions. At the present time there are nearly a hundred spectroscopic binaries known with periods which range from a few days to two and a half years.

According to Doppler's principle of motion in the line of sight, the lines will be shifted toward the red end of the spectrum if the distance between the source of light and the observer is increasing, but toward the violet end if this distance is decreasing. The grandest application is seen in Keeler's proof ('Astroph. Jour.,' I., 416, 1895) of the meteoric constitution of Saturn's rings. If meteoric, the linear motion of the rings will be greatest nearest the planet and decrease outward, if solid the rings will rotate as a whole, all particles having the same angular motion, the linear speed increasing from centre to circumference. With solid rings, and a slit placed across the planet's equator, the lines on the side moving toward us would be shifted toward the region of short wave-lengths, the shift being proportional to the linear motion. While for the side moving away from us the lines would be shifted in the opposite direction. Thus, on account of the gradual increase in linear motion from centre to circumference, the lines would be gradually shifted, in the complete spectrum having the effect of lines slightly inclined. Such, however, is not the appearance of the lines photographed by Keeler, and these can be explained only under the assumption that the rings are a collection of small satellites, giving, therefore, a direct confirmation of the mathematical theory of Maxwell.

An important application of line of sight measurements is in determining the motion of the solar system through space. The "apex of the sun's way" may be found from proper motion determinations, or from line of sight measurement used separately, but in a more satisfactory way by applying both methods of research. The right ascension and declination of the point toward which the sun is moving is found from recent measures to be $\alpha = 280°$, $\delta = 35°$ north. This point is situated in the constellation Lyra about 4° from the first-magnitude star Vega. Campbell's determination of the velocity is 19.89 ± 1.52 kilometres per second, a speed which would carry our system over almost exactly four radii of the earth's orbit in a year. When more information is received from the line of sight measurement of the southern hemisphere, a better redetermination of this problem will be possible.

The spectra of stars naturally fall into several types. Secchi's classification is as follows:

Type I.— White or blue stars, the spectrum characterized by the breadth and intensity of the hydrogen lines with metallic lines very faint. This type includes more than half the stars.

Type II.— Yellow stars like our sun, with spectra resembling that of the sun very closely, consisting of a great number of fine dark lines.

Type III.— Red and orange stars, including most of the variables. The spectrum is crossed by numerous dark bands or flutings, which are sharply defined on the blue side and shade off toward the red. α Orionis, Antares, and o Ceti are good examples.

Type IV.— Deep reddish stars, all faint. The spectrum resembles that of Type III., but the flutings are reversed in direction, being sharply defined on the red side. 152 Schjellerup is the best example.

Pickering has suggested a fifth type to include many stars having bright lines in their spectra, and the planetary nebulæ.

Other classifications are due to Vogel, Lockyer, and Miss Maury of the Harvard College Observatory.

One of the grandest problems of scientific research is undoubtedly the question of stellar evolution. By common consent the nebula is regarded as being the primordial matter. The first stage of development is represented, according to Huggins, 'Atlas of Representative Stellar Spectra' (London, 1899), a masterpiece with superb illustrations, by a star like A of θ Orionis, one of the stars of the great nebula. Orion and helium stars are followed in development by the white stars of Secchi's first type. Evolution can be traced step by step, through stages like those represented by the stars α Lyræ, Sirius, Castor (fainter star), α Aquilæ, Procyon, γ Cygni, till we come to the fully developed second type star like Capella and the sun. Increased absorption at the violet end of the spectrum give the red stars of Secchi's third and fourth types, which, according to Huggins, develop in parallel lines. The period of increasing old age is evident from the carbon absorption bands, and it is easy to imagine this absorption increasing in amount till the whole light of the star is cut off. But even at this stage, when the star gives no light, the spectroscope is not powerless to follow, for if the dark star accompanies a bright one, its presence is revealed through a change in the motion of the line of sight. There has been quite considerable discussion as to which star, Sirius or the sun, is in the hotter stage of development. The color of Sirius, and the maximum in its spectrum being more toward the violent end than in the case of the sun, would seem to indicate a higher temperature. Huggins and a great many astronomers think that the sun is in the hottest state, but that the great absorption in its atmosphere compared with that of Sirius, makes the color of the sun yellow The spectrum of the sun is almost identical with that of Capella, which shows that the sun is a star, rendered brighter and bigger on account of its nearness. The stellar magnitude of the sun is —26.4 on the same scale that Sirius is a star of magnitude —1.4. Thus, according to Newcomb, 'Stars,' p. 27, the sun gives us:

10,000,000,000 times the light of Sirius.

91,000,000,000 times the light of a star of magnitude 1.

9,100,000,000,000 times the light of a star of magnitude 6.

The square roots of these numbers show the number of times we should increase the actual distance of the sun in order that it might shine as a star of the corresponding magnitude. Under these conditions, the distance and parallax of the sun would be:

Sirius;	Distance,	100,000:	Parallax,	2″.06
Mag. 1;	Distance,	302,000:	Parallax,	0″.68
Mag. 6;	Distance,	3,020,000:	Parallax,	0″.07

From the large size of the parallaxes, it is evident that the sun must be a very small star in the heavens. But its nearness renders it a very important star, one in which we can study the second stage of stellar development in all its details.

Interesting work has been done by Hale in this field by the application of the spectroheliograph invented by himself. With the 12-inch telescope of the Kenwood Observatory, the prominences and the surface of the sun have been photographed in monochromatic light. More remarkable results have been obtained with the spectroheliograph and Yerkes' telescope ('Astroph. Jour.,' XIX., 41, 1904). Its great focal length of over sixty feet gives a solar image about seven inches in diameter, an increase in size which permits a more detailed study of the sun's surface. A photograph can be taken with the slit of the spectroheliograph at the centre of the K line at λ3933.8, another with the slit moved a trifle to λ3932, and still others with the slit at λ3929 and λ3924. These photographs show bright calcium patches on the face of the sun which Hale has called "flocculi," and the four of them not only differ from photographs taken with the calcium H and hydrogen F lines, but differ materially among themselves. These photographs are explained as being due to a difference in level of the gases, and from these and other results it seems probable that the calcium flocculi are in general made up of a series of columns, which expand as they reach higher levels, and in many cases overhang laterally.

Astrophysical work along entirely different lines has been carried out at the Astrophysical Observatory of the Smithsonian Institution. Langley's bolometer used in connection with a sensitive galvanometer, perfected in the hands of Abbot, can give an automatic record of the energy received from the sun. These bolograms and simultaneous observations made with the actinometer or pyrheliometer, permit an elimination of the variable absorbing effect of the earth's atmosphere, thus giving a measure of the energy from the sun that reaches the outside of the earth's atmosphere, or in other words, the "solar constant." Langley's determination made on the top of Mt. Whitney placed the value of the solar constant at 3.0 calories. Recent observations at Washington ('Astroph. Jour.,' XIX., 305, 1904) show that this number is probably too high, and also that the value is not a constant, but varies altogether about 10 per cent. Another research carried on at the Smithsonian, has been for the purpose of investigating the absorption of the solar envelope, by means of a long focus telescope and bolometer, with the result that it has been shown that likewise this absorption varies in amount. The most interesting part of the whole work has been the comparison with terrestrial temperatures rendered possible by the International Dekadenberichte. With temperature records from 85 localities in the north temperate zone, it has been unmistakably demonstrated that when the solar constant has a very low value terrestrial temperatures are below their average, and at the same time absorption in the solar envelope is large in amount. The interdependence of these variations brings to view one of the most important developments of astrophysics. That terrestrial temperatures should be shown to be closely connected with variations in the sun's heat is very remarkable; it would be still more startling if it should follow that we can forecast great temperature changes — a result which is not impossible.

Literature.—The best books on this subject are Kayser's 'Handbuch der Spectroscopie' and Scheiner's 'Astronomical Spectroscopy' (Frost's translation). S. A. MITCHELL,

Department of Astronomy, Columbia University.

Astruc, as'truk', **Jean,** French physician: b. 19 March 1684; d. Paris, 5 March 1766. He acquired high reputation as an anatomist, and was the author of 'Venereal Diseases' (1736), and other medical works. The work, however, which has immortalized him is purely theological and is entitled 'Conjectures as to the Original Materials of Which Moses Seems to Have Availed Himself in Composing the Book of Genesis' (1753). In this he divides the book of Genesis into two parts, on the ground of the use of Elohim (God) or Yahveh (Jehovah). He holds that these two names for the Deity point to the fact that Genesis was compiled from two parallel, independent documents. His memoir forms the origin of modern criticism on the Pentateuch.

As'trup, Eivind, Norwegian explorer: b. Christiania, 1870; d. 1896. He was a member of the first and second Peary expeditions, 1891 and 1893, and made the first survey of the northern coast of Melville Bay. He perished while on a snowshoe expedition from Dovre, Norway.

Astura, äs-too'ra, a maritime village of Italy, 40 miles from Rome. In its little harbor a high tower is said to stand on the site of the villa of Cicero, where Cicero was slain by order of Antony 43 B.C.

Asturias (as-too'ria), **The,** a former principality of Spain. To this mountainous country of the north of Spain the Goths retreated in the 8th century before the sword of the Saracens. The inhabitants of Asturia are said to be less industrious than the Galicians, and less sociable than the Biscayans. The hereditary prince of Spain has borne since 1388 the title of Prince of Asturia, or of the Asturians, according to the obsolete division into Asturia de Oviedo and Asturia de Santillana, Oviedo and Santillana being the two chief cities of the principality. Since 1838 the principality has been officially known as the province of Oviedo. See Oviedo.

Asty'ages, the last king of Media, reigned 594–559 B.C. In the latter year he was dethroned by Cyrus, who, according to Herodotus, was his grandson. Cyrus revolted in 559, and defeated Astyages, whom he took prisoner, but afterward appointed governor of Hyrcania.

Astyanax, sometimes known as Scamandrius. A Greek legendary character, the son of Hector and Andromache.

Asuncion, å-soon'the-ōn, or **Nuestra Senora de la Asuncion** (in English, *Assumption*), the capital of Paraguay, on the river Paraguay. The principal edifices are the cathedral, several other churches and convents, the president's palace, house of congress, arsenal, custom-house, a college, hospital, railway station, etc. The trade of the town is in Paraguay tea, tobacco, fruits, hides, timber, provisions, manufactured goods, etc. Steamers and sailing vessels ply on the river. The town was founded on the feast of the Assumption in 1537, hence its name. Pop. (1900) 51,700.

Asurnazirpal, ä'soor-nä'zĕr-pal, a king of Assyria from 881 B.C. to 860. He was one of the most warlike of Assyrian kings, and in numerous campaigns enlarged his empire, especially toward the westward, extending it from Lebanon to the Tigris. He also rebuilt Calah, his capital, and left a record of his achievements in the so-called 'Standard Inscription.'

Aswal, ăs'wăl, a Hindu name of the sloth-bear. See Bears.

Asy'lum, a place where persons flee for protection. Under the Mosaic dispensation cities of refuge were set apart to which the slayer might flee so that innocent blood should not be shed, in case the person was not worthy of death — that is, in case the act was accidental and not malicious. But among the ancients, outside of the Jews, it seems that temples, statues to the gods, and altars particularly consecrated for such purposes, constituted places of refuge for persons generally, and it was deemed an act of impiety to remove, forcibly, one who had fled to such an asylum for protection. However, Tiberius abolished all asylums except the temples of Juno and Æsculapius. These asylums finally passed over to the Christian world, and under Constantine the Great, all Christian churches were made asylums for all those who were pursued by officers of justice or the violence of their enemies, and the younger Theodosius, in the year 431, extended these privileges to all courts, gardens, walks, and houses belonging to the Church. In the year 631 the Synod of Toledo extended the limits of asylums 30 paces from every church, and this privilege afterward prevailed in Catholic countries, and it is said to have been a strong armor of defense against the wild spirit of the Middle Ages, and not without good consequences at the time when force often prevailed against justice. But in later times as other and better systems of procedure in the administration of justice became adopted, asylums were abolished in most countries. This seems to have been the origin, nature, and object of asylums, and such the common acceptation of the term, but more recently in some countries, the name has been given to institutions for the protection and care of the poor, blind, deaf and dumb, and lunatics who are incapable of taking care of themselves.

Asy'lum, Right of, in international law, the right which forbids one government to apply its laws to its own or its enemy's subjects when they are within the jurisdiction of another government. Most commonly this right is accorded to a foreign legation to shelter persons subject to the jurisdiction of the State where the legation is situated. It is universally conceded that the right of asylum is not to be applied in the case of ordinary criminals, but it is usually made use of for the protection of political offenders.

Asymmet'ric (as-i-met'rik) **System,** in crystallography, the crystal form now more commonly called "triclinic." It was called asymmetric because it has no plane of symmetry. See Crystal.

Asymptote, ăs'ĭm-tōt (from three Greek words, meaning "not to fall with" or coincide), a term used in geometry to designate a line which continually approaches another line, but never meets it, however far either of them may be prolonged. At least one of the lines must be a curve. Though the very existence of such a line seems paradoxical, it can be demonstrated

on the strictest mathematical principles, as in the case of the hyperbola and its directrix. The term first occurs in the conic sections of Apollonius.

At Odds, the title of a novel by the Baroness Tautphœus (1863), dealing with the vicissitudes of a Bavarian family during a stormy epoch from Hohenlinden to Wagram. It is told with a happy ease and directness; and if it has not the brilliancy of 'The Initials,' is not less clever as a study of character.

Atacama, ä'tä-kä'ma, the name, formerly, of two South American provinces: (1) A northern province of Chile, with an area of 28,380 square miles, and a population (1895) of 59,713. About 1,000 silver and 250 copper mines are worked, and gold is also found in considerable quantities. Salt deposits cover sometimes 50 square miles. Copper, to the value of over $7,500,000 annually, is the chief export to England. Capital, Copiapo. (2) A Bolivian Department, which formerly extended as far north as Peru, and east to Argentina. All that part of the district west of the Andes was ceded, in 1884, to the Chileans, and formed into the Department of Antofagasta, with an area of 60,770 square miles. The recently discovered mines of Caracoles are said to be the most productive silver mines in the world. The former capital, Cobija (pop. 2,380), was long the only port in the district; but the rival port of Antofagasta, founded in 1870, had by 1894 attained a population of 7,946.

A'taca'ma, a desert region on the west coast of South America, formerly belonging partly to Bolivia, partly to Chile, but now belonging wholly to the latter. It lies between the Andes and the sea and much of it at the height of 3,000 to 5,000 feet above the sea. The desert of Atacama proper, a tract almost entirely destitute of water and vegetation, lies partly in the Antofagasta territory of Chile, partly in the province of Atacama. The soil consists of stones and gravel, and the surface is diversified with many mountains. The Salina of Atacama, a salt morass, mostly dried up, has a surface of 1,084 square miles, and lies at the height of over 7,000 feet.

Atacamite, -tak'-, a mineral, originally found as sand in the Atacama province, in northern Chile. It is essentially a hydroxychlorid of copper, having the formula $CuCl_2.3Cu(OH)_2$. It crystallizes in the orthorhombic system, and has a hardness of from 3 to 3.5, and a specific gravity of 3.76. Atacamite is green in color, and commonly occurs either massive or in the form of sand. A coating having the same chemical composition is formed on metallic copper, as the result of prolonged exposure to sea-water or air. Atacamite exists in considerable quantity in various parts of South America, and in Australia; and has been used to some extent as a source of copper. In the United States it is found at Jerome, Arizona.